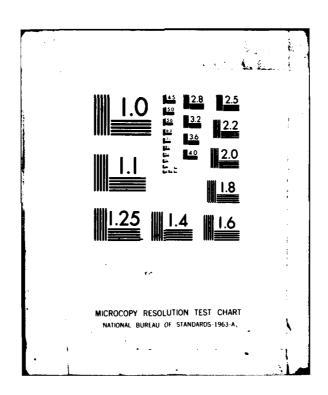
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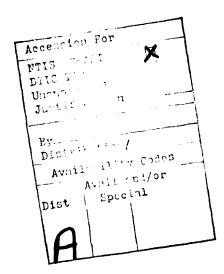
A STUDY OF TIME CONSTRAINTS RELATED TO FACILITIES ACQUISITION IN SUPPORT OF NEW WEAPONS SYSTEMS INITIAL BEDDOWNS

Kevin P. Hansen, Captain, USAF

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This research effort investigated the interrelationships between the weapons system acquisition process and the facilities acquisition process. Independent PERT networks were developed for each acquisition process and a probability distribution was determined for each process. Comparison of the probability distributions showed that the facilities acquisition process could be expected to take approximately 13 months longer to reach an initial operational capability than the weapons system acquisition process when both are measured from the start of full-scale development for the weapons system being supported. The two independent PERT networks were then integrated into a single network which was analyzed to determine ways to compress the facilities acquisition process to meet the same initial operational capability as the weapons system acquisition process. Various alternatives to allow compression of the facilities acquisition process were examined, and a proposal to restructure the interface activity "tie-in" points between the two acquisition process was developed.

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A STUDY OF TIME CONSTRAINTS RELATED TO FACILITIES ACQUISITION IN SUPPORT OF NEW WEAPONS SYSTEMS INITIAL BEDDOWNS

A Thesis

Presented to the Faculty of the School of Systems and Logistics of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirement for the Degree of Master of Science in Engineering Management

Ву

Kevin P. Hansen, BS Captain, USAF

September 1981

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This thesis, written by

Captain Kevin P. Hansen

has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN ENGINEERING MANAGEMENT

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ii

TABLE OF CONTENTS

		Page
LIST OF	TABLES	v
LIST OF	FIGURES	νi
CHAPTER		
1.	INTRODUCTION	1
	Statement of Problem	6
	Research Objectives	7
	Justification	8
	Scope/Limitations	9
2.	THE ACQUISITION PROCESSES	12
	The Weapons System Acquisition Process	13
	The Conceptual Phase	14
	The Validation Phase	16
	The Full-Scale Development Phase	18
	The Production Phase	20
	The Deployment Phase	21
	The Facilities Acquisition Process	22
	The Requirements Phase	22
	The Programming Phase	24
	The Design Phase	25
	The Construction Phase	26
3. 1	METHODOLOGY	28
	Facility Acquisition Network	29

Chapter			Page
Wea	pons System Acquisition Network		34
Int	egrated System Acquisition Network		46
4. ANALY	sis		47
Fac	ility Acquisition Network Model Analysis	·	48
	pons System Acquisition Network Model alysis		54
Int	egrated Acquisition System Model Analysi	is.	58
5. ANALY	SIS OF ALTERNATIVES		67
	shing the Facility Acquisition Process		68
Res	tructure Integration Points		72
6. CONCL	USIONS AND RECOMMENDATIONS		78
Con	clusions		79
Rec	ommendations		79
Rec	ommendations for Further Study	•	80
APPENDIX A:	FACILITY ACQUISITION MODEL INPUT DATA	•	82
	WEAPONS SYSTEM ACQUISITION MODEL INPUT DATA		87
APPENDIX C:	INTEGRATING ACTIVITIES		94
APPENDIX D:	FACILITY ACQUISITION NETWORK	•	96
APPENDIX E:	WEAPONS SYSTEM ACQUISITION NETWORK	•	110
APPENDIX F:	INTEGRATED ACQUISITION NETWORK	•	132
APPENDIX G:	INTEGRATED ACQUISITION NETWORK, CRASHED FACILITIES SUBNETWORK	. •	163
	INTEGRATED ACQUISITION NETWORK WITH AMENDED PROGRAMMING PHASE		177
SELECTED BIBL	IOGRAPHY		191

LIST OF TABLES

Tabl	le .					Page
	<.					
1	Acquisition Intervals for Selected Aircraft	:				
	Systems	•	•	•	•	38

LIST OF FIGURES

Figure	e	Page
1	Time Estimate Determination	. 33
2	System Life Cycle	. 36
3	Fighter and Attack System Development Time Summary Since World War II	41
4	Fighter and Attack System Development Time Summary Since 1955	43
5	Facility Acquisition Process Network Logic Diagram	50
6	Facility Acquisition Process Probability Distribution	. 54
7	Weapons System Acquisition Process Network Logic Diagram	56
8	Amended Facility Acquisition Process Probability Distribution	59
9	Comparative Probability Distributions	60
10	Integrated Acquisition Process Logic Diagram	63
11	Facilities Acquisition Subnetwork Revised Logic Diagram	71
12	Programming Phase Subnetworks	75

CHAPTER 1

INTRODUCTION

Weapons system development and acquisition in the United States has undergone many different strategies throughout the years, but it wasn't until David Packard became Deputy Secretary of Defense that what might be called a balanced approach involving the Office of the Secretary of Defense (OSD) and the individual services evolved for weapons system development and procurement (20:4). The Packard legacy involves services' control of individual systems development, while OSD maintains overall control by reviewing and controlling further developments of individual weapons systems at specific phase points.

Another legacy of the Packard era is the increased use of hardware prototyping in weapons system development. Prototyping fell into disuse during the McNamara years in favor of total package procurement (TPP), wherein engineering studies and systems analyses were used to evaluate weapons system proposals and to award production contracts based on these paper studies. The TPP concept has evolved in an effort to reduce the costs and time for development of new weapons systems as a result of the rapidly escalating costs associated with these systems. It was thought that this "would allow the government greater cost control during all phases with a minimum of

government examination of the contractor's cost data [20:3]."

The Packard philosophy of a return to prototyping overturned the TPP concept in favor of hardware prototyping so that actual hardware could be evaluated. Prototyping offered several advantages over TPP, including "providing a hedge against strategic uncertainty, . . a hedge against technological uncertainty, . . and a hedge against cost uncertainty [16:15-16]." In the words of former Secretary of the Air Force, John L. McLucas:

Although prototypes are costly, looking back at previous programs one can see instances where the total cost could have been less had prototypes been used. Essentially, a prototype is insurance. It insures us that our ideas will work, and that we will not be forced to make major changes late in the development or during production when costs for changes are high. Prototyping is investment in knowledge. We believe that the cost of acquiring that knowledge is frequently more than offset by the consequent reduction of later risks [16:17].

Still another advantage of prototyping is that competition can be maintained for longer periods in the acquisition cycle, which encourages higher quality products. Additionally, there is a much better data base for a development decision if the design approaches are translated into hardware (8:32).

Despite these advantages, there are some disadvantages attributed to using prototype development, the same disadvantages that lead to the introduction of the TPP strategy for systems acquisitions. These disadvantages can be consolidated into two main areas: increased cost and a longer development time. But a 1963 Rand report found no statistical support

that development programs involving large initial commitments cost less than prototype programs, nor was there statistical support for the claim that prototyping increased development time (12:v). The conclusions found in the 1963 Rand report were further confirmed with a 1980 Rand report that reexamined the same problem (20).

The changes in acquisition management fostered by Mr. Packard were incorporated into DoD Directive 5000.1, Major System Acquisitions, which was first issued in 1971. In 1976, the Office of Federal Procurement Policy issued Circular A-109, establishing a federal policy for acquisition. (Circular Á 109 is now issued by OMB.) Circular A-109 requires that:

Development of a single system design concept that has not been competitively selected should be considered only if justified by factors such as urgency of need or by the physical and financial impracticality of demonstrating alternatives [27:10].

This requirement for competition stipulated by Circular A-109 has been fully recognized in a revised DoD Directive 5000.1.

But while the framework for weapons systems acquisitions has now been standardized, considerable latitude is given in how particular programs are managed. It can be safety stated that no two system acquisition programs are alike (8:6), and that change is the only constant in a system development. These changes occur both philosophically, such as in the acquisition strategies to be used, and technologically, such as when new requirements or processes for manufacture emerge.

As regards the philosophical changes:

Constant changes in acquisition strategy have been made in an attempt to eliminate the problems of a previous strategy; e.g., fly-before-buy, total package procurement, two-step procurement, and life cycle cost/design to cost have all been used over the past 20 years as acquisition strategies. . [13:3].

Technological changes, as used herein, refer not only to hardward changes, but also to factors that influence these hardware changes for a given weapons system. Although the following quote may be somewhat exaggerated, it does illustrate the pervasive nature of technological change in a weapons system development.

. . . the operational requirements for defense systems may change one or more times a year. After each change, Government and industry managers must prepare new plans, new schedules, and new budgets. This process occurs repeatedly during the validation stage of an acquisition program and throughout the remainder of the life of the program [10:106].

The dynamic, continually changing environment of major systems acquisitions also impacts on support functions that must concurrently develop, acquire, and deploy support equipment and facilities required by the weapons system. In the area of facilities support, for instance, changes concerning weapons system acquisition strategies can affect facility development schedules and acquisition timetables. Technical changes, on the other hand, can alter facility designs or construction methods, and also impact on schedules and integration requirements.

When a competitive prototyping acquisition strategy is employed for a weapons system, additional problems of safeguarding contractor sensitive information in a manner so as

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to not "favor one of the contractors and to avoid technical transfusion between competing proposals [2:185]" must also be solved. Additionally, initial designs and development work for facilities and support equipment may have to be duplicated until the competitive prototype phase is complete and a final choice is made about further development of a single system.

The resolution of problems created by such a dynamic philosophical and technical environment is further exacerbated by the different developmental tracks that weapons systems hardware and facilities follow. The weapons system, for instance, is managed by a single program manager (PM) and the system program office (SPO) to establish a single point of contact for all engineering, financial, and managerial direction required by the weapons system contractor. Also, all funding is obtained through the annual military appropriations bills in the categories of research and development and procurement.

The facilities acquisition process, on the other hand, is initiated by the base at which the facility is to be built, can be designed by in-service or contract personnel, can be managed during construction by the Air Force, the Army Corps of Engineers, or the Navy Facilities Engineering Command (depending on the location and urgency), is financially administered by an Air Force Regional Civil Engineer (AFRCE), is built by a local area building contractor, and accepted by the host base civil engineering organization, the AFRCE,

and the MAJCOM. Funding for facilities support is obtained through the Military Construction Appropriation from Congress, which is a separate appropriation and follows a slightly different budget cycle than other general fund appropriations (26:66).

Statement of Problem

In order to achieve a common initial operational capability (IOC) date, all of the aforementioned problems must be dealt with and solved for the concurrent development and acquisition of both the weapons system hardware and the support facilities. But the interface points between the weapons system acquisition process and the facilities acquisition process do not seem to be well understood by all affected parties, nor is their impact on system timetables and schedules fully determined.

This research effort, then, will explore the interface points between the weapons system acquisition process and the facilities acquisition process, when both developmental processes have the same IOC constraint at the first base to operationally deploy the new weapons system and the weapons system is acquired under the competitive flyoff strategy.

While it is impossible to adequately address every facet of the management problems inherent in the acquisition of facilities to support new weapons system beddowns, the intent of this study is to test the hypothesis that the

procedural requirements of the formal military construction program (MCP) are not responsive to time constraints necessary for the acquisition of new or remodeled facilities required to support the initial beddown of new weapons systems acquired under the fly-before-buy/competitive flyoff strategy.

A definitive acceptance of this hypothesis could lead to different procedures for developing and acquiring support facilities for new weapons system beddowns, and can more accurately focus management attention on those particular areas where procedural changes would be most effective.

Research Objectives

In order to test the hypothesis stated above, the primary objective of this research is to develop a PERT/time network for the integrated weapons system/facilities acquisition process, determine the critical path activities and duration for this integrated network, and examine the influence of integrating activities within the integrated network. This primary objective will be achieved by accomplishing the following subobjectives:

1. Provide a broad overview of the facilities acquisition process and the weapons system acquisition process, with special attention given the competitive flyoff acquisition strategy, so as to establish a common information baseline for all subsequent analysis. Additionally, providing such an overview will provide integrating information for readers who are not familiar with the weapons system

acquisition process of the facilities acquisition process;

- 2. Develop a PERT network diagram for the facilities acquisition process, and a probability distribution for the duration of the facilities acquisition process from the PERT network;
- Develop a probability distribution for the weapons system acquisition process;
- Develop a PERT network diagram for the weapons system acquisition process, and use it as the model for competitive flyoff weapons system acquisition procedures;
- 5. Determine the critical path for each network diagram developed in subobjectives 2 and 4 above, and perform some comparative analyses between the two networks.

Justification

The use of network analysis in the evaluation of this research hypothesis has a number of significant analytical advantages. First, network analysis can tell the whole story by showing all critical relationships between different activities (14:136). A prime consideration in this research effort is that network analysis also increases awareness of the problems involved, and their relative importance in the overall operation (5:1). Finally, network analysis offers flexibility in the level of aggregation used in developing the network, with different levels of summarization available for different levels of management. Aggregate networks help to eliminate the parochial viewpoint that each department

or agency has in its own view of the project and their particular place in it (14:137-138).

Network analysis based on completion of the previously noted subobjectives offers an opportunity to identify critical interrelationships and allow better planning and enhanced control in future developments.

Scope/Limitations

The competitive flyoff acquisition strategy will be the only acquisition strategy studied because of time constraints on the study. Because only one strategy can be studied, the competitive flyoff strategy has three properties which make it especially worthy of analysis. The first of these properties concerns the dual development that characterizes the initial stages of this weapons system acquisition strategy. This dual system development requires some redundancy in systems support, such as when different facilities requirements must be planned for both weapons systems in the competition. The second property concerns the safeguarding of competition sensitive information during the initial stages of the acquisition process, so as to not give one contractor any kind of unfair advantages over another. The third and final property relates to the different schedule milestones that are encountered in a competitive strategy. This reflects the fact that different weapons systems under consideration in a competitive strategy will not have the same schedule milestones for deployment, due to

manufacturing and design differences, as well as such factors as leadtime requirements for major components and other supplier constraints.

These three properties distinguish the competitive flyoff strategy from other acquisition strategies so much so that an analysis of facilities support for the competitive flyoff strategy may not be precisely relevant for any other weapons system acquisition strategy. But these same constraints could be especially demanding of facilities support efforts and, therefore, warrant initial attention.

The A-10 weapons system will be used as the model for the weapons system acquisition process because it was the first system since the TPP era to be fully developed and procured under the competitive flyoff strategy. Also, the A-10 system development appears to be representative of development using the competitive flyoff strategy for all weapons systems, and development data is readily available for analysis.

The facility acquisition process analysis will be based on the construction of a single facility that costs approximately \$5 million and is funded through the MCP. Basing the analysis on a single facility still allows for concurrent development of other facilities that may be required to meet an IOC, but does not overly complicate the network with multiple parallel development plans for each facility being acquired under the same MCP funding appropriation. It should be noted that the facility being assumed for acquisition in

this study does not imply that that kind of facility, or facilities of the same general characteristics, are required to beddown new weapons systems. Many weapons systems beddowns require no MCP-funded facility construction, and some require even more than is assumed to be required here.

Also, the facility studied in the network will be assumed to be a high priority project with the Army Corps of Engineers serving as the design and construction agent. Other general assumptions are that: 1) the facility development will require an environmental assessment, but with a finding of no significant impact (FONSI); 2) the major command who will operate the weapons system at the beddown base also has the responsibility for the base; and 3) the major command will be designated to serve as the AFRCE, rather than one of the three regional AFRCEs under Headquarters, USAF. From the discussion with Mr. George Taylor, Chief of Systems Facilities Branch, Aeronautical Systems Division Civil Engineering, these conditions present reasonable and not atypical construction program characteristics for a new weapons system beddown (23).

Finally, another basic assumption is that the facility must be fully operational before the IOC can be considered complete. This necessarily precludes operational use of the weapons system until the facility is fully operational.

CHAPTER 2

THE ACQUISITION PROCESSES

Before a full understanding of the integrated weapons system acquisition process/facilities acquisition process can be obtained, it is first necessary to establish a common baseline of information for comparison and analysis. This chapter will offer a brief overview of the weapons system acquisition process and the facilities acquisition process. Because of the complexity of each of these acquisition processes, only the most important elements of each will be presented here, with the intent being to capture those elements of each acquisition that are common to all applications of such an acquisition.

This broad overview is intended to provide the baseline of information for the more detailed analysis that is
the focus of this research effort, and it is also intended
to give the reader a more complete understanding concerning
the whole acquisition process. Additionally, it will help
put the more detailed PERT networks in perspective and,
hopefully, make them easier to understand and interpret. The
overview presented is intended to be descriptive rather than
normative, so as to enhance understanding as much as possible
and yet not be prescriptive regarding any particular acquisition strategy or methodology.

The weapons system acquisition process will be described first, since it is preeminent over and encompasses the facilities acquisition process in the development and deployment of a weapons system.

The Weapons System Acquisition Process

The weapons system acquisition (WSA) process for major weapons systems consists of five phases, with three major decision points. The five phases are the conceptual phase, the validation phase, the full-scale development phase, the production phase, and, finally, the deployment phase. The three major decision points are called Milestones I, II, and III, and require approval from the Secretary of Defense (SECDEF) before the WSA for that particular system can proceed.

Even before the conceptual phase begins, however, an operational need must exist to justify the development of a new weapons system.

The Air Force looks to the major commands to continuously analyze their mission capabilities and identify operational needs. Operational needs may result from a projected deficiency or obsolescence in existing systems, a technological opportunity, or an opportunity to reduce cost [8:11].

A Statement of Operational Need (SON) is developed for those operational needs that cannot be satisfied with existing capabilities, and that will likely lead to a new system development. Validation of the SON by the appropriate authority constitutes the Milestone O/Program Initiation decision and commencement of the conceptual phase. For major

systems, an additional document, the Mission Element Need Statement (MENS) is prepared and used to communicate the need to the SECDEF before the Milestone O/Program Initiation Decision.

Following SECDEF approval of the MENS, HQ USAF provides formal direction to the implementing and participating commands by using a Program Management Directive (PMD). The PMD is used during the entire acquisition life cycle to state requirements and request studies as well as initiate, approve, transfer, modify or terminate programs [8:18].

The Conceptual Phase

The conceptual phase is highly iterative, but can be categorized into three sections: identification, analysis, and approach preparation.

The identification section is concerned with identifying alternative means of satisfying the Statement of Need. Industrial contractors, government laboratories, and educational institutions can all be involved in the identification of alternatives to meet the mission need. Active participation by the operational command is also required during the identification of alternatives effort to insure system alternatives properly reflect user needs and preferences.

Rigorous analysis is performed on all of the proposed alternative solutions to determine the feasibility and the risks involved in the proposals. Theoretical cost estimates are developed, as well as many tradeoff studies, and some "breadboard" studies may also be performed to support assertions or proposals (17:2).

The approach preparation section of the conceptual phase concerns the formulation of the management team and the generation of the management program to be used for further development of the system. During the conceptual phase, the program manager is designated, along with the charter stating his responsibility, authority, and accountability (8:19). A functional baseline for the weapons system is established by the newly-formed program office during this phase that includes broad system performance objectives, an operational concept, a logistics concept, and cost estimates (3:2-8).

Another major product of this phase is the Program Management Plan (PM!). This includes initial development of the Statement of Work (SOW) and Request for Proposal (RFP), as well as specifying the basic management approach to be used in any further phases of the program. The PMP also specifies aspects of program office/contractor relationships, the types of management reports to be generated, the Program Cost Schedule Control System (PCSCS), the master program schedule, the targeted IOC date, and other managerial control information (3:2-9).

The findings and recommendations generated during the analysis period of the conceptual phase are consolidated into a decision coordinating paper (DCP) that is presented for DSARC I review and subsequent DSARC recommendations concerning program continuation. The DSARC recommendations are presented to the SECDEF for his approval. The SECDEF-approved

DCP constitutes the program continuation decision and Milestone I.

The Validation Phase

The SECDEF's approval at Milestone I is communicated to the system program office (SPO) through a revised PMD, which initiates the validation phase of the system acquisition process. The objectives of the validation phase are to determine whether to proceed with full-scale development for the system, and to establish firm and realistic performance specifications which meet the operational and support requirements (3:3-5). The thrust of the effort to meet these objectives is to reduce the technical risk and economic uncertainty through a more detailed definition of the new system.

The validation phase is typically accomplished predominantly by defense contractors under SPO direction in one of three ways: 1) design definition paper studies, 2) hardware prototyping, or 3) some combination of both (17:2).

Design definition is an approach to validation wherein two or more defense contractors, under the SPO's direction, use system studies and detailed engineering analysis to define the proposed system. The resultant products, using this strategy, are detailed system specifications, performance specifications, initial hardware configuration specifications, refined cost estimates, and schedule projections. This detailed paperwork is then used by a source selection board to

evaluate the proposals and detailed studies and select the best proposed system for further development (17:2-3).

In the hardware prototyping strategy, actual system hardware is fabricated and evaluated in a competitive flyoff. For a flying system such as a new fighter aircraft, this involves building and flying a testbed system. It is important to understand that this approach is concerned with "the fabrication of a system resembling the operational system only to the extent that performance objectives can be validated [1:55]." The data gathered from the competitive flyoff constitute part of what is presented to a source selection board for evaluation and selection of the best system for further development.

While the hardware prototyping strategy has achieved its greatest notoriety from whole system competitive flyoffs, it is also used extensively for subsystem development, test, and evaluation. Avionics, armaments, propulsion systems, and almost all other subsystems can be competitively tested. In very large system acquisitions, where a total system competitive flyoff is cost prohibitive, subsystem hardware "competitive flyoffs" can and have been successfully employed.

A corollary effort to the hardware fabrication and testing effort in the competitive flyoff strategy is the development of contractor, full-scale development program management plans. These plans are structured so they can be implemented contractually for full-scale development. These plans must specifically answer questions concerning system

producibility, management ability, and other system specific information (3:3-8).

Near the end of the validation phase, the source selection authority will select that system that is recommended for further development in the full-scale development phase of the WSA process. Also in the validation phase, the SPO develops the RFP for the full-scale development phase.

The SPO also generates an updated DCP at the end of the validation phase that is forwarded through the DSARC process for DSARC II and subsequent SECDEF approval. SECDEF approval of the updated DCP constitutes Milestone II, or the Ratification Decision, and the commencement of the full-scale development phase (3:3-11).

Approval to proceed into the full-scale development phase is based on assurance that:

- (1) System tradeoffs have produced a balanced and realistic set of performance parameters.
- (2) Risk areas have been identified and reduced to acceptable levels.
- (3) Cost/schedule estimates for full-scale development are acceptable.
- (4) Contractual aspects are sound (terms and conditions are appropriate to risk, and funding related to milestones) [3:3-11].

The Full-Scale Development Phase

The full-scale development phase follows the validation phase, with the objective of this phase being the fabrication and testing of pre-production prototypes. To accomplish this objective, the system design is finalized with comprehensive and complete design reviews, and engineering drawings

are prepared. It is also during this phase that the critical design review is held, which is the "last chance to comment on the developing design before commitment to accept the design [8:35]."

A major effort during this phase is development, test, and evaluation (DT&E). The DT&E purpose is to:

- Demonstrate that engineering design and development are complete,
- [Demonstrate that] design risks have been minimized,
- Demonstrate that the system or equipment meet specifications, and,
- Verify that proposed design changes do not degrade overall system performance [8:37].

Another type of testing conducted during the full-scale development phase is initial operational test and evaluation (IOT $\S E$). The objectives of IOT $\S E$ are to:

- Estimate military utility, operational effectiveness and suitability;
- Provide feedback prior to key milestone decisions;
- Demonstrate that the system can be supported logistically in a deployment status;
- Identify new uses for the system; and
- Reshape tactics [8:39].

The IOT&E is an operational assessment of a system where the whole system is evaluated against operational criteria. IOT&E is the complete system-testing conducted before a production decision, while complete system-testing after a production decision is called follow-on operational test and evaluation (FOT&E).

It is important to note that the prototype fabricated during the validation phase for a competitive prototyping strategy is different from the pre-production prototypes fabricated during the full-scale development phase. The

prototypes fabricated during the full-scale development phase are "more representative of the operational system than was the validation phase prototype, which emphasized performance characteristics [17:3]."

During the full-scale development phase, detailed logistics support planning, deployment planning, and training plans are formulated to support the production decision and the production phase. Extensive production planning and some limited expenditure on production may also occur during this phase (3:4-6).

After sufficient testing and developmental planning, a revised and updated DCP is prepared and submitted to the Secretary of the Air Force for review. The DCP then proceeds through DSARC III for approval and is then forwarded to the SECDEF for his approval. His approval constitutes the production decision and the initiation of the production phase and Milestone III.

The Production Phase

The fourth phase of the weapons system acquisition process is the production phase. During this phase, the system enters into production in two distinct periods. In the first period, initial tooling and production is accomplished to bring the system production to the planned peak rate. The second period is concerned with follow-on production after the peak rate is achieved (3:5-1).

Sometime during this phase, program management

responsibility transfer (PMRT) is also accomplished. PMRT is the formal act of termination of the implementing command's program management responsibility and the transfer of that responsibility to the Air Force Logistics Command (AFLC) (3:5-6).

One of the main management functions during the production phase is the physical configuration audit (PCA). During this audit, the detailed specifications are compared with the production hardware and all acceptance tests are verified to be complete.

The Deployment Phase

Immediately following the production phase, and most often concurrent with it, the deployment phase covers the introduction of the new system into the field for operational use. In this stage all support facilities and equipment must be fully developed and ready for use. This includes activation and operation of depot support for the system, as well as all required support at operational bases.

Congressional review and funding of the WSA is accomplished during all five phases of the WSA process. SECDEF decisions at Milestones O, I, II, and III must subsequently be included in the Five Year Defense Plan (FYDP) at the next Program Objectives Memorandum (POM) submission (8:18). This insures Congressional review and Congressional control of each specific weapons system acquisition program's funding and schedule.

The Facilities Acquisition Process

The facilities acquisition process often acts in support of the weapons system acquisition process to provide new or modified facilities to support the weapons system operation, but the facilities acquisition process also acts independently to provide support facilities not associated with any particular weapons system. Despite the reason for the facility, or how the requirement for the facility is generated, all facility acquisitions follow essentially the same process. Those construction projects with a funded cost of less than \$500,000 do not require submittal through the military construction program (MCP), while those projects with a funded cost over \$500,000 do require submittal through the MCP (25:2-8). This review of the facilities acquisition process will only cover the formal MCP process.

There are essentially four phases to the facilities acquisition process under the MCP. They are: 1) requirements identification and justification, 2) programming and funding, 3) design, and 4) construction.

The Requirements Phase

The requirement for a new facility may come from many sources. It may be generated as a result of a mission change for the base wherein existing facilities cannot adequately support the new mission. In these situations, the requirement for new facilities originates with an agency or office not located on the host base. This is the type of requirement

of concern in this research. For a new weapons system beddown, for instance, the facility requirements to support the
new weapons system are generated by the weapons system prime
contractor, who then forwards them to the host base civil
engineering organization and, concurrently, to the civil
engineering organization advising the SPO. The host base
civil engineering organization, in conjunction with the civil
engineering organization advising the SPO, then determines
which existing facilities are adequate to support the new
mission, which facilities will have to be modified, and what
new facilities will have to be built.

New facility requirements may also be generated by deficiencies in support of already existing base missions. Requirements of this type require strong justification by the user to fully document the deficiency and its impact on the user's mission.

Another means of identifying new facility requirements is when existing facilities must be replaced due to structural unsoundness, catastrophic damage, or because of hazards to health and safety. This type of requirement also includes replacing facilities that have deteriorated to the point they are not economical to maintain or operate. Extensive user participation in the justification is also required for this type of requirement identification to support the action proposed (25:3-1).

The Programming Phase

No matter how the requirement for a new facility is generated, the programming phase begins with the host base civil engineering organization. The host base civil engineering organization prepares an annual MCP submittal package (DD Form 1391, Military Construction Project Data) as specified in AFR 86-1, Programming Civil Engineer Resources, and in the MCP submittal guidance. This submittal package includes essential project information to support review requirements at higher command levels.

The initial DD Form 1391 package is submitted to the major command (MAJCOM) when the MAJCOM relays the MCP call message from HQ USAF to the bases for the annual MCP submittal. The MAJCOM reviews the base submittal for accuracy and completeness, and forwards the MAJCOM-supported program to HQ USAF by the date specified in the call notice.

HQ USAF reviews the submittals from the MAJCOMs and selects the projects that will be included in the POM and forwarded for OSD and Congressional review, approval, and funding. After HQ USAF has selected the supported program, design instructions are issued by HQ USAF to the MAJCOM or the AFRCE designated to be the project manager for those projects being supported, so that 35 percent design completion can be accomplished before the MCP program is presented to Congress.

After the base civil engineering organization has submitted the initial DD form 1391 package, work begins on

the full DD Form 1391 package and the project book (PB) for the projects being supported by the MAJCOM. This more complete documentation includes information essential to the design and construction of the project. This information is sent to the MAJCOM when it is requested, where it is reviewed and forwarded to HQ USAF and to the AFRCE, if the AFRCE is the design and construction management agency. The PB is prepared in accordance with instructions contained in AFR 89-1, Design and Construction Management.

After the PB is received at HQ USAF, the program is sent to OSD for review, and then it is sent to Congress for authorization and appropriation. The MCP is sent to Congress on the 15th of January each year, and Congress then holds hearings on it, with approval usually occurring in the following September. Funding is obtained after the President signs the bill and apportionment is accomplished.

The Design Phase

The design phase begins when HQ USAF issues design instructions as noted in the previous section. This design instruction is issued to the AFRCE, or the MAJCOM designated to function as the AFRCE, who then commences the design with an in-service design agent or initiates the selection of an Architecture-Engineering (A-E) firm to perform the design under contract. The Army Corps of Engineers or the Navy Facilities Engineering Command, as well as the Air Force MAJCOM, can serve as the in-service design agent. The determination of

an in-service or contract design is predicated on the type of project, urgency, and any special design considerations that may be required (11:12).

The design effort must be at least 35 percent complete before the project is forwarded to Congress for funding (19: 26) so the design phase occurs concurrently with the latter elements of the programming and funding phase. The objective is to have the facility 100 percent designed and construction contract preparation complete when the MCP bill is signed and the funding is apportioned.

The design effort involves extensive cooperation, coordination, and review by all interested and affected parties. This includes the user, the MAJCOM, the AFRCE, the base and the design agent, and involves extensive reviews at specific stages of design as specified in AFR 89-1. This close and detailed involvement in the design stage is intended to insure a minimum of design changes and maximize effectiveness for the using organization.

The Construction Phase

The construction phase begins as soon as the invitation for bids (IFB) is prepared and distributed to interested contractors. After bids are received and the contract awarded, a pre-construction conference is held to acquaint the contractor with any constraints that must be met concerning site access, material storage, and other preliminary information. The facility is then constructed by the contractor under the supervision of the construction agent, which is normally the same agency that served as the design agent. Continuing inspections of the facility during construction are accomplished by AFRCE representatives, and any deficiencies or corrections identified through these inspections are reported to the AFRCE, who then works through the construction agent to effect corrective action.

After the basic contract is complete, a pre-final inspection is accomplished, and all known deficiencies are identified for contractor corrective action. When all corrective action is complete, a final inspection is held, and if the facility is acceptable, the Air Force assumes responsibility and accountability for the facility from the contractor.

Once the facility transfer is complete, equipment installation that is not part of the basic contract can commence.

After all necessary equipment is installed and functionally checked, the facility is made available for user occupancy.

The foregoing reviews of the acquisition process have been intentionally broad and general in scope. This was done to provide a common foundation for further analysis. Subsequent analysis of each acquisition process for development of the network diagrams will build on this foundation and supply more detail for selected parts of the acquisition processes.

CHAPTER 3

METHODOLOGY

This chapter will discuss and explain the specific methodology used to acquire the data necessary to develop the independent facilities acquisition network, the weapons system acquisition network, and the integrated facility/ weapons system acquisition network.

In order to accomplish subobjectives 2 and 4, as stated in Chapter 1, two similar but different methodologies for data acquisition and organization were used. Each different methodology will be discussed as it relates to accomplishment of either subobjective 2 or subscriptions and data concerning the interfaces between the facilities and weapons system acquisition processes, will be discussed. Each of these three different investigatory methodologies was required because of the different ways in which the pertinent data elements were determined.

Three separate acquisition system models (activity networks) were also developed and will be discussed. These three models are: 1) the facility acquisition network model, 2) the weapons system acquisition network model, and 3) the integrated facility/weapons system acquisition network model. The facility acquisition network and the weapons system

acquisition network models were initially developed as stand-alone models, and they were then integrated into a single model--the integrated facility/weapons system acquisition network model.

The facility acquisition network data element determination and the associated model development will be discussed first. The weapons system acquisition network data element determination and its associated model development will be discussed second. Finally, the integration of the two models, and the determination of the necessary data elements to allow this integration will be discussed.

Facility Acquisition Network

The facility acquisition network model was derived primarily from the Facility Item X-amination (FIX) study conducted by the Engineering and Services staff at Air Force Logistics Command Headquarters in June 1980. The objective of that study was to develop a comprehensive model network for the facility acquisition process. To accomplish that objective, each of the major directorates under the Deputy Chief of Staff for Engineering and Services was tasked to prepare comprehensive networks for their functional area as it related to construction of a major MCP-funded facility. For instance, the Programs Directorate was tasked to identify all activities and events concerning project identification and programming, while the Engineering and Construction Directorate was tasked to identify all events and activities

related to facility design and construction (24:3).

These separately developed parts were then combined into a whole, complete network. The combined network had 756 activities identified, which resulted in a very detailed, but somewhat incomprehensible, facility acquisition network. The FIX project was never fully debugged or completed, however, because it was superceded by more urgent studies and requirements (7).

The data elements from the FIX network were used as the basis for the facility acquisition network developed for this study, but with some important changes. The first of these changes was the combination of many of the activities into one activity whenever possible. This higher level of aggregation resulted in a simpler, more easily understood network, but at the cost of some detail. This aggregation was necessary, however, because the extreme detail of the FIX network made it difficult to understand the network as a whole. There was so much detail that it was difficult to identify the essential tasks and activities, difficult to comprehend the total process work and information flow, and difficult to identify critical decision points in the process. These essential activities and events were masked by the sheer volume of information that was presented.

A second reason why the network was aggregated and condensed was because it was to be used as an input to the integrated acquisition network, and that network had to be comprehensible too. Because essentially all activities in

the facilities acquisition network were to be included in the integrated network, any excess complexity in the facility acquisition network would be continued in the integrated network, making it more difficult to analyze and understand.

Consistent with standard PERT practice (4: 5; 6), three time estimates (optimistic, most likely, and pessimistic) were developed for each activity in the facility acquisition network. These time estimates were derived from time estimates in the FIX network and by personal interviews with personnel on the AFLC Engineering and Services staff. Initial time estimates for the aggregated network were determined by simply adding corresponding time estimates between events in the FIX network that defined the aggregated activity. This method, however, causes a distortion of the probability distribution for the optimistic and pessimistic time estimates and could not be considered reliable for these time values. Such a methodology does not tend to disturb the most likely time estimate for the aggregated activity, however.

To verify the accuracy of the most likely time estimates as determined from the FIX network, and to more accurately assess the pessimistic and optimistic time estimates, personal interviews were held with the AFLC Engineering and Services staff. During these interviews, the staff personnel were asked for the optimistic, most likely, and pessimistic times for activities as they appear in the aggregated network. In all cases, the time estimates for the most likely times were consistent with the most likely time estimates determined

from the FIX network. The time estimates for pessimistic and optimistic times were used as determined from the interviews and not from the FIX network summation.

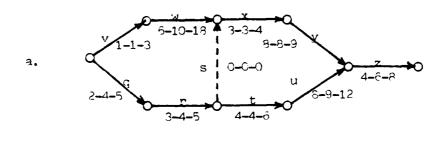
As an example, let Figure la represent the activities and events in part of the FIX network, and let Figure lb represent the corresponding aggregated activity as in this study. The initial estimate of the time values for Figure lb were obtained by summing the longest path in Figure la, or v, w, x, y, z and using the sums as values for aggregated activity A, as shown.

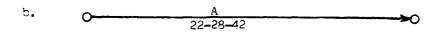
But since the optimistic and pessimistic time estimates in Figure 1b do not reflect the 1 in 100 chance for activity completion required for the beta distribution, the time estimates obtained from the personal interviews were used. Thus, the time estimates used for this analysis might turn out to be as shown in Figure 1c.

The logic of the facility acquisition network model was verified by having several civil engineering officers with various experience backgrounds review the model for consistency and completeness. Particular attention was paid to predecessor/successor event logic relationships in the model formulation, and these relationships were verified from elements of the FIX network, from the personal interviews, and by the civil engineering officer reviews.

The correlated and verified data were then used to develop the facility acquisition model for this study.

Appendix A contains the data input to the facility acquisition





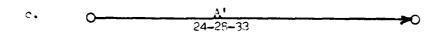


Figure 1
Time Estimate Determination

network model. The predecessor and successor event numbers defining each activity are given, as are the activity description and the time estimates used. It is important to note that all time estimates were input in weeks and days format. The last digit of each time estimate is days, but all digits preceding the last digit designates the activity duration in weeks. Thus, a time estimate of 213 means 21 weeks and 3 days, while a time estimate of 105 means 10 weeks and 5 days. Also included in the appendix is a numerical designator and description of the events in the facility network model.

Weapons System Acquisition Network

The data acquisition procedure for developing the weapons system acquisition model differed from the facility acquisition network model development because the A-10 weapons system had been selected as the model baseline and actual historical data were available and used. In other words, instead of a theoretical data baseline being used as in the facility acquisition model, actual dates and time interval data were available and used in the weapons system acquisition model development.

Further, only one activity duration time interval was used with each activity designated in the network, and the time interval used was the actual time required for accomplishment. This approach was used because data were not available to determine the optimistic, most likely, and pessimistic time estimates for each activity, but were available for the actual time durations that occurred. The problem with this approach is that the use of only one time estimate does not allow the development of a beta distribution for each activity, and thus does not allow the determination of variance for each activity in the network. The computer program used for analysis uses the single, actual activity time value the same way it uses the expected time value derived from the beta distribution when three time estimates are given.

The use of actual time data and only one time estimate is not to imply that there is not a great deal of variance

within individual activities and within major phases of a weapons system acquisition process. As was pointed out in Chapter 1, no two weapons system acquisitions are alike, and thus different time durations for their development must be expected.

Figure 2 shows various time estimates for the different phases of a weapons system acquisition. The variables of size of the program, importance of the program, acquisition strategy used, manpower available, funding, and other variables will all influence the system development and acquisition times for a given weapons system. The A-10 system development represents only one case of weapons system acquisition times, and using actual dates can only capture a "snapshot" of a dynamic situation.

Even though using the actual A-10 development times represents only one point on a continuum of possible development times, the A-10 system development as a whole is not inconsistent with the development times for other modern fighter and attack aircraft weapons systems. Table 1 shows major milestone dates for all major aircraft weapons systems since World War II, including prototype developments (designated by a P) and the A-10 system. The mean time between development start (FSD) and first flight for all tabulated fighter and attack aircraft systems, excluding prototypes, is 24 months, with a range of 9 to 37 months. The A-10 system took 25 months, a difference of only one month and less than .143σ (σ = 7.09 months) from the mean value. The mean time

SYSTEM LIFE CYCLE

A. C.	DEPLOYMENT	TURN OVER TO USER MOD IF ICATIONS EMPLOYMENT
11	DEPL	TURN O USER MODIFI EMPLO)
Phase &	PRODUCTION	SYSTEM PRODUCTION LOGISTIC SUPPORT PRODUCTION ENGINEERING
Phase (Phase	FULL SCALE DEVELOPMENT	ENG. DESIGN TEST AND EVALUATION SYSTEM FABRICATION SUPPORT
Phase & Phase &	VALIDATION	SOURCE SELECT. ENG. DESIGN PROGRAM TEST AND CHARACTER. EVALUATION PERF. SPEC. SYSTEM FROTOTYPE OR SUPPORT PLANNING
Phase &	CONCEPTUAL	TECHNICAL FEASIBILITY COST EFFECTIVENESS PREFERRED APPROACH

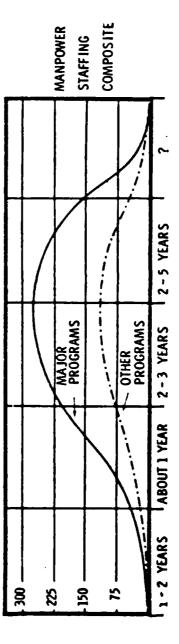


Figure 2

System Life Cycle [1:37]

for months to first delivery from FSD start for fighter and attack aircraft, again excluding prototypes, is 39.68 months, with a range of 14 to 68 months. Here the A-10 system took 34 months, a difference of 5.68 months, or .35 σ (σ = 15.96 months) from the mean.

The data in Table 1 span three decades, however, and it may reasonably be asked does this data display any trends, for instance, is "months from FSD to IOC" changing over time? Rand researchers who developed Table 1 did a regression analysis to test for trends in the time period from FSD start to first flight (column 3 in Table 1). The regression analysis yielded a line of nearly zero slope, indicating no statistical evidence that a trend has developed in the time from FSD start to first flight over the three decades encompassed by the data of Table 1, for fighter and attack aircraft only (20:25).

A similar regression analysis for the time from FSD start to first operational delivery was performed by the Rand researchers (column 5 in Table 1), again to test for trends over the three decade span. For fighter and attack types only, excluding prototypes, the analysis yielded a slope of plus five months per decade, with a significance probability of 15 percent (20:25). This finding led the Rand Corporation researchers to conclude that:

Although the regression tests suggest a change in interval duration of several months per decade, the large significance probability associated with all of the tests suggests some caution in asserting that any real change has occurred [20:25].

TABLE 1
Acquisition Intervals for Selected Aircraft Systems

Mode1	-	Devel- opment Start Date (1)	First Flight Date (2)	Months to First Flight (3)	First Opera- tional Delivery (4)	Months to First Delivery (5)	200th Opera- tional Delivery (6)	Months to 200th Delivery (7)	Time to Produce 200 a/c (8)
F-84	P·	11/44	2/46	15	6/47	31	4/48	41	10
F-84		1/45	1/47	24	6/47	29	4/48	39	10
F-86	P	5/45	10/47	29	5/48	36	10/49	53	17
F-86		12/46	5/48	17	5/48	17	10/49	34	17
F3D	P	4/46	3/48	23	8/50	52	4/53	84	32
F3D		6/48	2/50	20	, 8/50	26	4/53	58	32
T-89	P	6/46	8/48 ·	26	9/50	51	1/54	91	40
F-89		10/48	6/50	20	9/50	. 23	1/54	63	40
F-94		10/48	7/49	9	12/49	14	4/51	30	16
F4D F4D	P	12/48	1/51 6/54	25	5/55 5/55	77	8/57 8/57	104	27 27
F-100	P	10/51	5/53	19	10/53	24	7/55	45	21
F-100		2/52	10/53	20	10/53	20	7/55	41	21
F-101		10/51	9/54	35	5/57	67	5/58	79	12
F-102		9/51	10/53	25	6/55	45	1/57	64	19
F-104	P	3/53	2/54	11	1/57	46	12/58	69	23
F-104		7/54	2/56	19	1/57	30	12/58	53	23
F-105 F-106 F-4		9/52 11/55	10/55 12/56	37 13	5/58 6/58	68 31	4/61 4/60	103 53	35 22
F-111		5/55 12/62	5/58 12/64	36	12/60 4/67	67 52	10/62 12/69	89 84	22 32
F-14		2/69	12/70	22	5/72	39	7/76	89	50
F-15		12/69	7/72	31	11/74	59	7/77	91	32
F-16	P	4/72	2/74	22	8/78	76	1/81	105	29
F-16		1/75	12/76	23	8/78	43	1/81	72	29
F-18 F-18	P	4/72 1/76	6/74 11/78	26 34	5/80 5/80	97 32			
A3D A3B	P	3/49	10/52 9/53	43	1/55 1/55	70	6/60 6/60	135	65 65
A-4 A-5 A-6		6/52 6/56 1/58	6/54 8/58 4/60	24 26 27	8/55 2/60	38 44	12/57	66	28
A-7		3/64	9/65	18	4/62 3/66	51 24	2/67 1/6 8	109 46	58 22
A-10	P	12/70	5/72	17	11/75	59	5/79	101	. 42
A-10		1/73	2/75	25	11/75	34	5/79	76	42

Table 1, continued

Model	Devel- opment Start Date (1)	First Flight Date (2)	Months to First Flight (3)	First Opera- tional Delivery (4)	Months to First Delivery (5)	200th Opera- tional Delivery (6)	Months to 200th Delivery (7)	Time to Produce 200 a/c (8)
B-47 P	10/45	12/47	26	12/50	62	6/52	80	18
B-47	9/.48	6/50	21	,2/50	27	6/52	145	18
B-52 P	7/48	4/52	45	1/55	78	8/57	109	31
B-52	2/51	8/54	42	. 1/55	47	8/57	78	31
B-58	2/53	11/56	45	11/59	81			
B-70	12/57	9/64	81	Project	ct cancel	ed during	development	t
B-1	6/70	12/74	54	Proje			developmen	
C-130 P	7/51	8/54	37	:2/55	53	2/59	91	38
C-130	9/52	4/55	31	:2/55	39	2/59	77	38
KC-135P	5/52	7/54	26	1/57	56	1/59	80	24
KC-135	8/54	8/56	24	1/57	29	1/59	53	24
C-133	2/53	4/56	38	8/57	54			
P-3	4/58	11/59	19	3/62	47	12/66	104	57
C-141	4/61	12/63	32	10/64	42	4/67	72	30
C-5	10/65	6/68	32	10/69	48	٠, ٥,	**	50
S-3A	8/69	1/72	29	10/73	50			

⁽¹⁾ Formal start of aircraft development. Usually denoted by issuance of a contract, but sometimes by source selection when formal contract ratification was delayed but design work continued. The date shown applies to start of actual hardware design and development, not to the usual design studies that precede actual development. Occasionally (8-58, for example) a development program was started, then canceled, redirected, and restarted. The last such start is noted in the table.

⁽²⁾ Date of first flight of the very first flight article to emerge from the specified development project.

^{(3) (2) - (1),} in months.

⁽⁴⁾ Date at which the first fully operational configuration was accepted by the using service for operational inventory (as opposed to development testing). Note that this does not coincide with IOC, which usually implies delivery of servical aircraft to the using command, while the first operational aircraft may well go to a training unit. The intent here was to mark a milestone in the system development program, not to measure establishment of a true operational capability.

^{(5) (4) - (1),} in months.

⁽⁶⁾ Date of delivery of the 200th operational item (again excluding the units produced for development testing).

^{(7) (6) - (4),} in months.

^{(8) (6) - (1),} in months. [20:22-24]

The Rand researchers also did a regression analysis for the time from FSD start to 200th operational delivery for fighter and attack types only, excluding prototypes (column 7 of Table 1). The results showed a slope of 12 months per decade and a significance probability of 4 percent (20:30).

From their analysis, the Rand researchers concluded overall that:

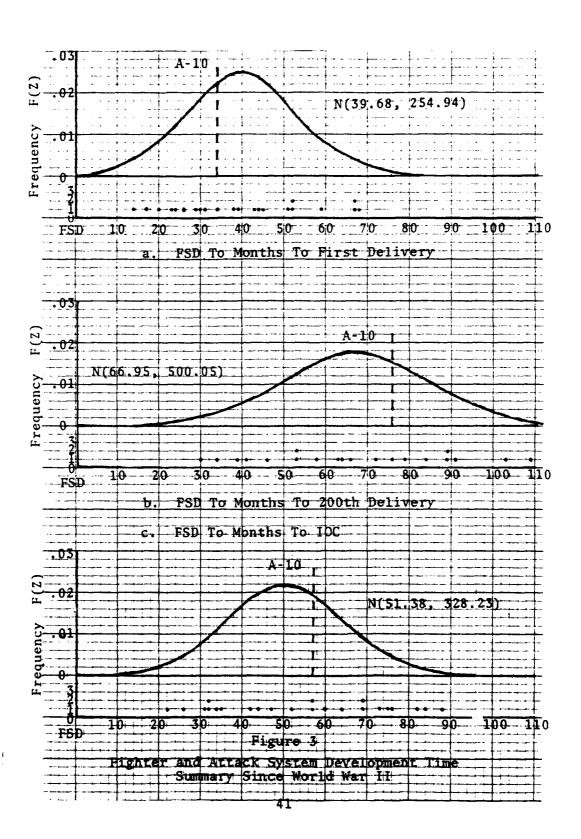
Changes in typical interval duration have been less pronounced in the phases immediately after the start of full-scale development. In fact, there is no evidence that the time required for the initial engineering development of the system has changed significantly during the past three decades. This is rather impressive, considering that aircraft of recent vintage tend to be much more complex than those of earlier times.

Although there is some slight evidence that the test phase (between first flight and first operational delivery) has been lengthening somewhat, the statistical support for such a trend is very weak. . . .

Finally, a clear change has occurred in the production phase of aircraft systems, where average production rate has been steadily decreasing over time [20:36].

The analysis of trends in the data from Table 1 suggests that a better approximation of expectations for future weapons system development times might be obtained by using only the more recent data of Table 1 for analysis. This conclusion seems especially relevant when the time interval under study includes part of the production phase.

To illustrate the impact of using only the more recent data for weapons system development times for fighter and attack types only, excluding prototypes, Figure 3 shows the scatter diagram and empirical distribution for the months to first delivery from FSD start, FSD start to 200th delivery,



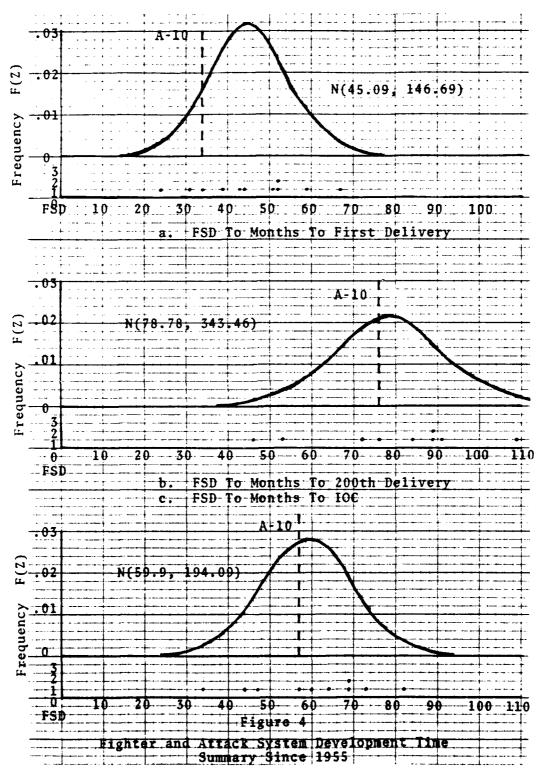
and FSD start to IOC for the data in Table 1. The data on the time from FSD to IOC are not included in Table 1, but were available from information in the Appendices of the same Rand report (20:44-76). The empirical distribution has been assumed to be normal, and the mean and variance for each time interval are shown.

Figure 4 shows the scatter diagram and empirical distribution for the same three time intervals, but limits the data points to fighter and attack type systems, again excluding prototypes, that have been developed since 1955. Again the empirical distribution has been assumed to be normal, and the mean and variance for each time interval are shown.

A Kolmogorow-Smirnov goodness-of-fit test was performed on the n=10 data points for Figure 4c, with the result that there is no statistical basis to reject the null hypothesis that the sample distribution is a normal distribution (D=.13).

As shown by Figure 4c, the A-10 weapons system development time appears to be representative of an approximately average weapons system acquisition time for fighter and attack type aircraft systems. And as stated in Chapter 1, fighter and attack type aircraft systems are also the most likely to be procured under a competitive prototyping strategy.

The time values used to develop the weapons system acquisition model were obtained from the history of the A-10 development maintained by the Aeronautical Systems Division



History Office at Wright-Patterson AFB, Ohio (28; 15; 22). This history contains the date of accomplishment of major milestones (events) during the A-10 development.

Logic relationships for the weapons system acquisition network model were developed from two sources. The logic relationships for activities in the phases of weapons system development prior to full-scale development contract award were derived from the network pattern displayed in Air Force Systems Command Pamphlet 800-3, A Guide For Program Management. Only key activities and interrelationships that clearly define the acquisition strategy in use, that capture important uncertainties, and that contribute to understanding the integration mechanism with the facilities acquisition network have been included.

The logic relationships for all activities subsequent to full-scale development contract award were derived from the network diagram developed by Fairchild Republic Company and used for overall system management during the A-10 acquisition (9).

As with the facilities acquisition network model, the weapons system acquisition model is at a higher level of aggregation than the constituent elements from which it is derived. The Fairchild Republic Company management network for the full-scale development and subsequent phases had 324 events designated, while the weapons system acquisition network model finally developed had only 117 events in total. This compression and aggregation was required to keep

unnecessary detail out of the network model, and to keep the model straightforward enough to readily identify important relationships and activities. Also, since this network model is also a constituent element of the integrated network model, the weapons system acquisition model could not be so large or so small as to obscure important relationships when the two subordinate models were integrated into one.

Each of the subordinate models was designed to capture the key interrelationships and activities for each acquisition process, and to capture those activities that are critical to the interface between the weapons system acquisition model and the facilities acquisition process model.

Finally, the weapons system acquisition network model was constrained to a ten-year calendar due to the requirements of the computer program used for analysis, and thus the early phases of planning and system definition that occurred prior to ten years before the IOC date were eliminated from the analysis. As a result of this time constraint, the beginning event for the weapons system acquisition network model is the re-orientation of the acquisition to a competitive prototyping strategy by the Secretary of the Air Force. Prior to this event, and not included in the network model, were detailed conceptual studies, mission analyses, and some contractor effort to determine different system alternatives for the mission need.

As in the facility acquisition network model, data were input using the weeks and days format for time estimates.

The data input to the weapons system acquisition network model is shown in Appendix B.

Integrated System Acquisition Network

The facility acquisition network model and the weapons system acquisition network model constitute the primary input data for the integrated system acquisition network model. The interface activity time estimates and logic relationships between the two subordinate models, as well as the identification of the interface activities themselves and their tie-in points, were determined from the files of the Aeronautical Systems Division Civil Engineering Office, Systems Facilities Branch, and from personal interviews with personnel from that office.

No new events were added to those already existing in the two subordinate and constituent network models. Various activities were added between the existing events to integrate the two models into one. The input data for the integration activities followed the same format as used in the preceding model developments. Time estimates were input as weeks and days, and all input data are shown in Appendix C.

Discussion of the three model networks, and the associated logic diagrams for each, is reserved for the next two chapters.

CHAPTER 4

ANALYSIS

This chapter will present the analysis of each of the three model networks, in turn. The analysis will examine the logic diagram developed for each of the three networks, identify the critical path in each network logic diagram, and examine the sensitivity of the critical path in each network. The sensitivity of the critical path in each network will be examined with a view as to what it takes to get a new critical path.

To a limited extent, the sensitivity of individual activities to duration changes will be examined. The vehicle for this examination will be the variance of each activity as determined from the beta distribution for each activity. Because only activities in the facility acquisition network and integrating activities between the facility acquisition network and the weapons system acquisition network have the three time estimates necessary to compute a variance, only they will be examined for sensitivity to change in individual activities.

For those activities for which a variance has been computed, the probability of each activity being completed by the scheduled date (or the latest allowable date if a scheduled completion date is not specified) will be examined. Special attention will be accorded to those activities with a low

probability of accomplishment.

Facility Acquisition Network Model Analysis

The computer-generated portion of the analysis of the facility acquisition network model is given in Appendix D.

The discussion and analysis of the facilities acquisition network presented in this chapter is based on that computer analysis, but will only address salient elements of the detailed analysis of Appendix D. The reader is referred to Appendix D for the detailed calculations for each activity and event in the network.

The facility acquisition network model construction and analysis was based on the assumptions given in Chapter 1. Additionally, a beginning date for the network was chosen that would provide an easily recognizable benchmark and that would allow direct comparison with the stand-alone weapons system acquisition network model. The beginning date of 15 January 1973 was chosen for the dummy start date for the network and does not imply that all facility acquisitions start in January or any other month. Requirements for new facilities can be generated and the programming cycle initiated at any time.

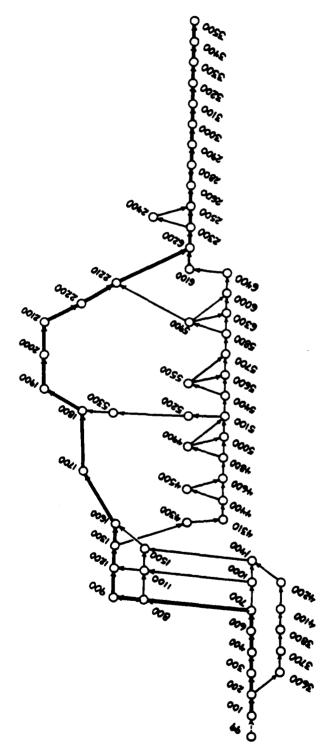
A number of required dates are associated with the facilities acquisition network model. These required dates denote deadlines that must be met for the annual MCP submittal, and are levied by the MAJCOM, HQ USAF, Office of the Secretary of Defense (OSD), and Congress to assure sufficient review and program selection time at each review level. For instance,

the MCP program must be submitted to Congress on the 15th of January in the year it is programmed (1975 for this study).

OSD requires the MCP program by the preceding October (October 1974), and HQ USAF requires the full project books for the MCP program in the preceding August (August 1974).

The MAJCOM, in turn, requires the full project book (PB) one month earlier (July 1974). The abbreviated project book must be submitted to the MAJCOM by the preceding November (November 1973). The initial DD Form 1391 must be received by HQ USAF in October of that same year (October 1973), and the same document must be submitted to the MAJCOM two months earlier (August 1973).

The activities and events enumerated in Appendix A are shown graphically in Figure 5 as a logic diagram. The minimum slack, or critical, path is identified by the doubled activity line. Only the event numbers are shown in Figure 5, but cross-referencing the event numbers with the activity and event descriptions given in Appendix A identifies the critical path as being the programming and approval process, including the Congressional authorization and appropriation. Specifically, the critical path follows the development of the initial DD Form 1391 submission, through the MAJCOM and HQ USAF reviews, and the inclusion of the facility requirement in the POM. The critical path continues through the OSD and Office of Management and Budget (OMB) review process into the Congressional authorization and funding. After Congressional and Presidential approval of the MCP, the critical path continues through



Facility Acquisition Process Network Logic Diagram

Figure 5

the funds disbursement process and culminates in facility construction, inspection, and equipment installation.

The abbreviated PB development process has a minimum slack of seven weeks, as does the full PB development. The abbreviated PB review at MAJCOM and HQ USAF does allow for issuance of the design instruction with 13.7 weeks of slack, however.

The environmental impact analysis process, events 3600 through 4200, when constrainted as given in Chapter 1, has 44.5 weeks of slack, and thus could not create a new critical path unless that slack is eliminated.

More importantly, the design process, events 4300 through 6400, has only 13.7 weeks of slack to meet the requirements of 35 percent design before the project will be submitted for Congressional funding and approval. After the 35 percent design milestone, slack increases in the design process to 16.8 weeks. While 13.7 to 16.8 weeks of slack may seem to be a long time, the design process can slip this amount if there is very much lost design. Lost design is that design effort that is wasted because of changes in requirements or changes to specifications that require a redesign effort. The standard deviation for the design process as a whole is 2.18 weeks, which was obtained by taking the square root of the sum of the variances along the longest expected path from event 4310 to event 6400.

The duration of the critical path in the facility acquisition network model is five years, five and one-half

months. The IOC date for the facility in this model is in June 1978, given the network start date as January 1973.

Turning now to the amount of change in individual activities, the variance for all but eight activities in the facilities network is less than one week. The maximum individual activity variance is 3.61 week² for the POM preparation by HQ USAF. Interestingly, the complete project book preparation variance is close to this maximum at 2.89 week². The facility construction variance is 1.69 week², as is the variance in collecting comments from the preliminary design conference. The programming phase of the facility acquisition process contains the most variance in individual activities. As can be seen from the critical path, any change in the programming phase directly impacts the critical path and the total project duration.

The probability of individual activities being accomplished by the scheduled date (or the latest allowed date if a scheduled date is not specified) is also of interest in the facility acquisition network. The probability for each activity along the critical path is .50, while the probability of accomplishment for those activities with slack increases commensurate with the amount of slack available, up to a maximum probability of .99. There is no probability given in the stand-alone facility acquisition network model of less than .50.

One further point about the probabilities of individual activities. For those activities on the critical path

and for which a required or scheduled date has been specified, the expected date for accomplishment of that activity occurs sufficiently before the required or scheduled date to allow a .99 probability of completion. This implies that the required or scheduled dates may have excess slack "built-in" beyond what is necessary for any single project. However, it must also be recognized that in any given fiscal year program, there are many hundreds of projects submitted and all are processed and reviewed subject to the same required and scheduled date constraints.

A probability distribution for the facility acquisition network as a whole is shown in Figure 6. This distribution is for the time duration from when the requirement is identified until the facility is complete and ready for use, including the installation and checkout of any required equipment. Also, it is predicated upon the same assumptions applicable to the facility acquisition model development. The distribution in Figure 6 was determined by summing the expected activity duration values (t_e) of individual activities along the critical path of the facility acquisition network to determine X, and using the formula:

$$\sigma_{T_E} = \sqrt{\Sigma(\sigma_{t_e})^2}$$

where σ_{T_E} is the standard deviation of the network as a whole and $(\sigma_{t_e})^2$ is the variance for each individual activity along the critical path. The values of T_E and (σ_{t_e}) for each

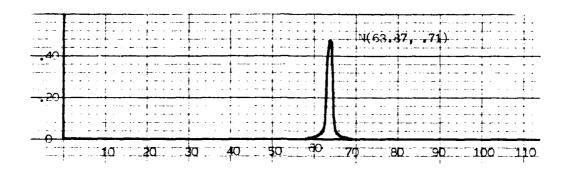


Figure 6
Facility Acquisition Process
Probability Distribution

activity in the network are shown in Appendix D.

Weapons System Acquisition Network Model Analysis

The computer-generated portion of the analysis of the weapons system acquisition network model is given in Appendix E. The discussion and analysis of the weapons system acquisition network, as with the facility acquisition network, is based on that computer analysis. Again, only salient elements of the detailed analysis of Appendix E will be addressed. The reader is again referred to Appendix E for the detailed calculations for each activity and event in the weapons system acquisition network.

As with the facility acquisition model, only the initial network start event was specified in the analysis as an accomplished date. All other dates in the analysis were calculated as expected dates. The expected dates shown in Appendix E are, in fact, close approximations to the actual

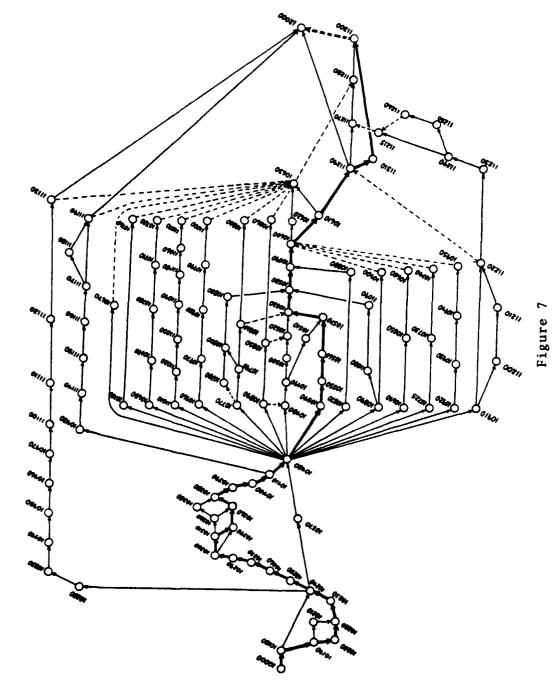
dates that that event or activity was accomplished, but because the computer program used for analysis was not designed to analyze already completed activities and events, it was necessary to modify the way the data were input and not denote them as actual dates to allow eventual analysis of the integrated network. Thus, the dates specified as the expected dates are, in fact, close approximations to the actual dates, even though they are not so annotated in the computer-generated output.

The designated network start date was October 10, 1969, which is the date the Secretary of the Air Force redesignated the program into a competitive prototyping strategy.

Figure 7 shows the network logic diagram for the A-10 system development, as constructed from the activities and events of Appendix B. Again, the critical path is shown by a doubled activity line. As with Figure 5, only event numbers are shown in the logic diagram, and these must be cross-referenced with Appendix B to determine activity and event descriptions.

The duration of the critical path in the weapons system acquisition network is eight years, given the start date already noted, with the IOC declared for the A-10 in mid-October, 1977. Another important date to note is the date of the decision to proceed into full-scale development, January 1973. This is the same month that was used as the start date for the stand-alone facility acquisition network.

The critical path involves the PMD development and finalization, DSARC I, the selection and fabrication of the



Weapons System Acquisition Process Network Logic Diagram

56

competing prototypes, the flyoff and evaluation of the prototypes, the DSARC II to the final prototype selection. In the
FSD phase, the critical path follows through contract award,
into tool planning, design, and manufacture for the preproduction prototypes, and into final assembly and construction of the pre-production prototypes. After the DSARC IIIA
decision for initial production, the critical path continues
through aircraft production and on to equipping test and
training units, then equipping the first operational unit to
meet the IOC.

Prior to the award of the FSD contract, all activity slacks are very close to zero, and thus even small changes in activity durations could alter the critical path.

After the award of the FSD contract, there are many activity paths that have little slack and could change the critical path if there are excessive delays or rework required. Among them are the release of specifications for vendor-supplied items, the finalization of the aircraft design, including the release of structural drawings and the design of jigs and final plans. Other activity paths with little slack include the gun and avionics testing, as well as the contract monitoring and planning that is done by the SPO. Finally, the initial aircraft delivery, test and DT&E, and initial operational cadre training are also very close to the critical path and could force it to change with any significant delays in any of these activities.

It must be noted that the description of the

sensitivity of alternative paths through the network to becoming the critical path is somewhat tenuous because actual dates are used. In some of these "near critical" paths, the durations for individual activities could have been intentionally lengthened up to the available time for their completion. If this is true, the calculated slack values are questionable.

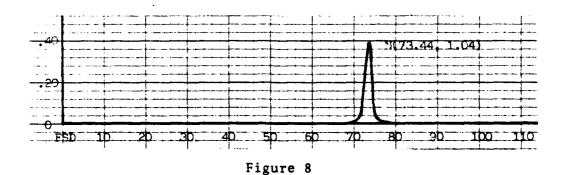
Because the variance for individual activities in the weapons system acquisition network were not computed, the sensitivity of individual activities to change is impossible to determine.

Figures 4a, 4b, and 4c presented in Chapter 3 show the estimated overall probability distribution for total development times of fighter and attack weapons systems developed in the recent past.

Integrated Acquisition System Model Analysis

The facility acquisition network probability distribution shown in Figure 6, when compared with the distribution for the weapons system shown by Figure 4c, offers a convenient starting point for analysis of the integrated acquisition system. But since the facility acquisition network probability distribution of Figure 6 was based on the requirement identification at base level as its starting point, it does not share the same starting milestone as does Figure 4c, the weapons system process probability distribution from FSD to IOC. The facility acquisition process can be expanded to begin at the FSD decision point, however, by adding one

integrating activity and determining the optimistic and pessimistic time estimates for the time interval between the decision to proceed into full-scale development and the actual contract award for FSD pre-production prototypes. This was done by adding the contractor preparation of the facility requirements report activity and by having an expert in weapons system development provide estimates for the optimistic and pessimistic times for activity 10410-10420, the final contract negotiations between the announcement of the FSD decision and the competition winner and the signature of the FSD contract with the winner (21). (The three time estimates for these two activities are shown in Appendix C.) The resulting probability distribution for the facility acquisition process starting from the FSD decision is shown in Figure 8.



Amended Facility Acquisition Process Probability Distribution

When Figure 4c is overlaid on Figure 8, as is shown in Figure 9, the difference between the expected durations of the two acquisition processes is apparent, and it is evident

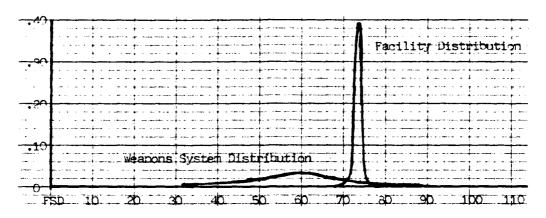


Figure 9
Comparative Probability Distributions

that the two processes are not syncronous. Figure 9 shows that the facility acquisition process, under normal procedures when funding is obtained through the MCP, is not compatible with the weapons system acquisition process if both have to meet a common IOC.

But the question then arises as to what activities can be crashed or otherwise amended so as to make the two processes' probability distributions more syncronous? A detailed discussion of the answer to this question will be deferred to the next chapter, but the integrated acquisition system network, using the A-10 as the representative system for the weapons system acquisition process under a competitive prototyping strategy, can allow investigation into what can be done. First it is necessary to investigate the integrated network as it results from the combining of the facilities acquisition network and the weapons system acquisition

network when no special actions on any activities or events are allowed.

A computer analysis of the integrated network is included in Appendix F. Three separate analyses of the integrated network were performed to assess the influence of the required and scheduled dates inherent in the facility acquisition process procedures. These will be discussed in more depth below.

First, it is necessary to discuss the integrating activities between the facilities acquisition process and the weapons system acquisition process. There are essentially four areas where the two processes interface directly, the first being the contractual requirement of the weapons system prime contractor to supply a facility requirements report identifying the real property facility requirements needed to support the new weapons system entering FSD. This report is normally initially required 180 days after the FSD contract is awarded, and is periodically updated to reflect weapon system design refinements that change facility requirements.

The second main interface between the two acquisition processes reflects the fact that the weapons system design must be finalized before the supporting facility design can be finalized.

Third, the site activation task force (SATAF) facilities sub-committee works concurrently with base, MAJCOM, AFRCE, and SPO personnel to minimize problems in the final stages of facility construction and equipment installation to insure

that all constituent elements necessary to become operationally capable come together at the same time. The SATAF facilities subcommittee is a controlling and coordinating body organized to facilitate a smoother weapon system beddown.

The fourth and final interface is related to a basic assumption of this study, and that is that the facility must be usable before the operational unit can be considered to have reached an initial operational capability.

A logic diagram for the integrated acquisition process is shown in Figure 10. The integrating activities, in the order they were described above, are 10420-100, 10500-6000 (the black square denotes the activity arrow has been broken and is continued elsewhere), 11310-2900, and 3500-11300. The critical path for the integrated network is shown by the doubled activity lines, and was the same path in all three analyses completed. The time duration characteristics of the three analyses differed significantly, however, and need to be addressed separately and in more detail.

The first analysis, included as Appendix F, was based on the facility acquisition network model, including all required and scheduled dates as given in the stand-alone facility acquisition network model. Two significant results are shown by this analysis. The first is that the duration of the critical path, based on the same start date used in the stand-alone weapons system acquisition model analysis, has increased the expected date of the IOC to late February 1979, an increase of one year and four months from the IOC in the

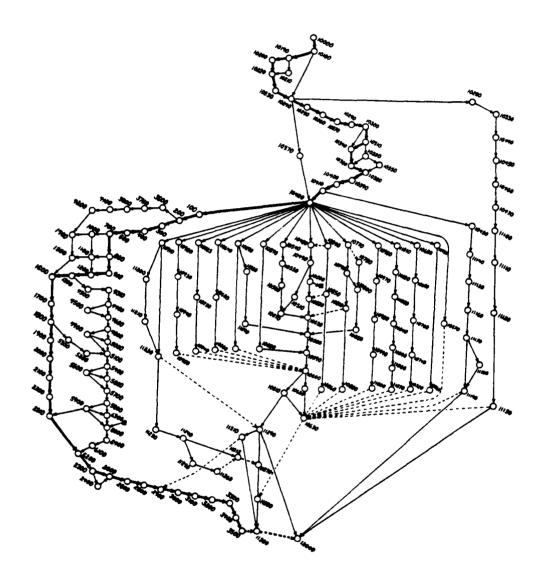


Figure 10

Integrated Acquisition Processes Logic Diagram

NOTE: The black square indicates the activity line has been interrupted for that activity and it is continued where the other black square is located.

stand-alone weapons system acquisition network model.

The second significant result is the negative slack calculated for all activities on the critical path, or even fairly close to it, prior to the required date the MCP program for the facility acquisition is sent to Congress. A negative slack means the latest allowable date for completion of an activity is before the expected date for completion of the same activity. Put another way, it means that the activity should be completed before it can reasonably be expected to be completed. In this case, the maximum negative slack has a value of -27.8 weeks, or approximately six months, and occurs for each activity on the critical path prior to event 1700, MCP program submission to Congress. This large negative slack infers that either the events prior to when the MCP program is sent to Congress should be initiated six months earlier or the fiscal year program in which the facilities are to be acquired should be moved back one year, in this case from FY 1975 to FY 1976. Moving the program back will necessarily delay the IOC by six more months, however, since the program submission to Congress is on the critical path.

The sensitivity of the critical path in this integrated network analysis is essentially the same as that in each stand-alone network previously discussed, except at the juncture where the facilities subnetwork breaks off from the weapons system subnetwork. The slack prior to event 10420, FSD contract award, is -27.8 weeks along the critical path. After event 10420, and within the weapons system subnetwork,

the lowest slack is 68.4 weeks.

Clearly the facility acquisition process is a binding constraint when new facilities are required before a weapons system can be declared operationally capable.

Finally, it is worthwhile to note that for those activities prior to MCP program submission to Congress and on the critical path, the probability of each activity on the critical path being completed by the required date is approximately .01.

The second integrated activity network analysis was based on the same input data as that included for the analysis described above, except that only the date the MCP program was sent to Congress was retained as a required date. The constraints on all other required dates as specified in the stand-alone facilities acquisition analysis were relaxed, since for some special, high priority requirements, these time constraints can be waived.

Essentially the same findings as those presented in the preceding analysis were revealed. The only difference was that the most negative slack was reduced to -24.4 weeks. The total duration and route of the critical path was not reduced or changed, and there was only 3.4 weeks reduction in the sensitivity of any paths through the weapons system acquisition subnetwork becoming part of the critical path.

The third integrated activity network analysis used the same input data as the first integrated analysis, but eliminated any required or scheduled dates. This was done solely to allow analysis of an unconstrained acquisition process to identify any significant changes and does not reflect a real situation or real conditions. Again the same critical path, and the same total duration of the critical path was found as in the previous two analyses. The negative slack was eliminated, and all activities on the critical path that had had a negative slack had a different latest allowable date calculated. The expected and latest allowable dates for MCP program submittal to Congress, for instance, occurred in July 1975, which was six months out of phase with the actual requirement as has been previously noted.

Under all three analyses, the "tie-in" points of the interface activities was not changed, and no possibility of activity crashing was input into the computer analyses. This posture was maintained to provide as realistic a picture as possible of the way the normal structure and procedure of the acquisition processes now are designed to interface with each other.

The analysis of the acquisition networks in this chapter has shown the incompatibility between the normal procedure of the facilities acquisition process and the weapons system acquisition process. The next chapter will examine how that incompatibility is currently resolved, and analyze some other alternatives for resolving the incompatibility.

CHAPTER 5

ANALYSIS OF ALTERNATIVES

Acquainted now with the structure, time duration, and other characteristics of the facility acquisition model, the weapons system acquisition model, and the integrated systems model, it is worthwhile to examine some alternative means whereby the IOC for facility completion in the integrated model can be made essentially equivalent to the IOC in the stand-alone weapons system acquisition model. This involves either a compression or re-orientation of the facilities acquisition model (based on the assumption that the weapons system is to be operationally capable as soon as possible), because the critical path in the integrated model proceeds through the facility acquisition model subnetwork and extends the IOC beyond what actually occurred.

Essentially, there are three basic alternatives available to make the expected duration through the facility acquisition process equal to the expected duration from FSD start to IOC in the weapons system acquisition process. The first alternative, and the one currently employed, is to crash activities in the facility acquisition network. A second alternative is to restructure the integration points between the facility acquisition process and the weapons system acquisition process. This alternative also implies some

restructuring of the facility acquisition process. The third alternative is to completely restructure the facility acquisition process and make it subordinated to, and under the control of, the weapons system program manager.

The first two alternatives will be discussed in further detail, but the third alternative listed is beyond the scope of this study, since it involves very strong political interests as reflected in the close Congressional control exerted over the military construction program. Also, there are many facility construction projects funded through the MCP that are not tied to any particular weapons system beddown.

Crashing the Facility Acquisition Process Model

This analysis will show how the facility acquisition subnetwork must be compressed, or crashed, to allow the IOC established in the stand-alone weapons system acquisition model to be achieved in the integrated acquisition model.

network model, it is necessary to discuss briefly the approach used to define crashed activities. "Crashing" involves developing a new plan, one in which the assumed work pace is accelerated. This is accomplished by procuring added equipment and more personnel, working overtime, scheduling concurrently whenever possible, etc. Crashing an activity generates a new and different probability distribution from the beta

distribution for an uncrashed activity. For analytical purposes in this study, however, the expected value of the crashed activity distribution has been assumed to be equal to the most optimistic time estimate given in the beta distribution for an uncrashed activity. This assumption was made because the crashed activity distribution was not available for each activity in the facility acquisition network.

The first step in crashing the facility acquisition process, for this analysis, involved crashing all activity times for events along the critical path of the facilities acquisition subnetwork, to the most optimistic completion time as given by the three time estimates defining the beta distribution for each activity. Even this crashing did not reduce the total duration of the facilities acquisition process sufficiently to allow either the program to be presented to Congress by the required date or for the facility to be ready for use by the required IOC. Further crashing was necessary in both the programming phase and in the construction phase.

Specifically, in the programming and approval phase of the facility acquisition process, the only truly firm required date is the date the program is sent to Congress.

According to one source on the HQ USAF staff, new programs can be submitted to HQ USAF as late as December and have them included in the January budget submission that goes to Congress. However, the program must be in the POM, and must be coordinated with all other funding accounts (18). Also according to the same source, such severe compression of the normal

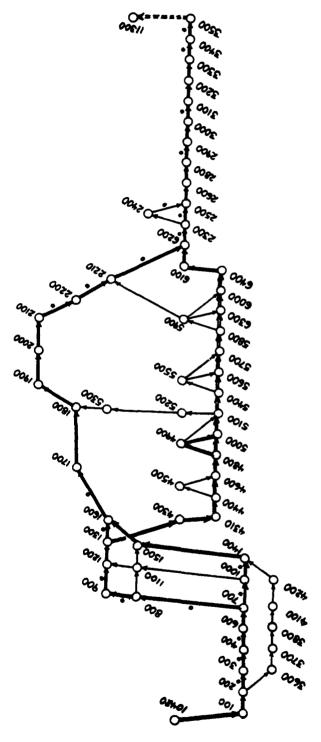
headquarters review and selection process is not uncommon for high priority facility projects, such as those associated with a new weapons system beddown.

Not only must activities prior to submission of the program to Congress be extraordinarily crashed, but activities in the construction phase, especially the facility construction itself, must be extraordinarily crashed. Extraordinary crashing refers to a crash time that is less than the optimistic time estimate from the beta distribution for an uncrashed activity. This extraordinary crashing is done in the construction phase through contractual requirements, but adds costs that the building contractor passes on the government in his bid price (23).

The result of crashing the critical path in the facilities subnetwork, and of extraordinary crashing elements of the programming and construction phases, is shown in Figure 11, a revised logic diagram for the facilities acquisition subnetwork, and are tabulated for each activity in the integrated network in Appendix G.

As can be seen from Figure 11, where all the critical paths are shown by doubled activity lines, the result of all this crashing is a network with multiple critical paths.

While the generation of multiple critical paths reduces the total process duration, it also increases management complexity. Further, slippage along any of the critical paths will delay the whole process. Nultiple critical paths also serve to diffuse management attention over many simultaneous



Facilities Acquisition Subnetwork Revised Logic Diagram

Figure 11

E: A dot above the activity line denotes crashed activities.

activities, instead of allowing management to focus on a few key specific activities along one critical path. In effect, multiple critical paths takes away from management the option of management by exception (4:19).

There is also higher risk, and the associated higher cost, inherent in multiple crashed critical paths. The opportunity is greater for some important function or activity to be less than the best product in order to meet the rigorous schedule demands. For facility projects, this equates to a higher risk of inadequate programming, higher risk of lost or incomplete design, and higher risk of insufficient funding level estimates and funding appropriations.

As mentioned earlier, crashing activities is the method of facility acquisition process compression used now. All of the hazards associated with this approach, as mentioned above, have been experienced in actual practice (23). Crashing activities in the facilities acquisition process was the method employed in meeting the A-10 IOC.

Restructure Integration Points

The second option for compressing the facility acquisition process is to restructure the integration points between the weapons system acquisition process and the facility acquisition process. To analyze this option, it is first necessary to more fully understand the facility acquisition process programming phase.

The facility acquisition process programming phase

has two essential functions. The first function, accomplished through the initial DD Form 1391 submission, is to provide a line item input into higher command level budget planning. This input is used to allow the MAJCOMs and HQ USAF an opportunity to initially review and select from among the projects submitted those that will be supported for that fiscal year MCP program. For high priority projects, such as new weapons system beddowns, the initial DD Form 1391 submittal establishes a budget planning figure for development of the POM, and it serves as the paperwork record in high level reviews.

The second input from base level in the programming phase is the abbreviated project book. This document further refines the facility construction cost estimates and provides further information for review to allow final selection of those projects that will be supported further through the process.

The final base-level product from the programming phase is the complete project book (PB). This document provides detailed cost estimates, and all baseline information from which to develop the facility design. It also serves as the final document in the higher headquarters review and approval process, especially before Congress.

Essentially, however, the first two documents serve as inputs for review, approval, and selection of projects that will be included in the POM. The last document serves as the baseline for design, and for support of those projects in the POM that are being defended before Congress for authorization

and funding.

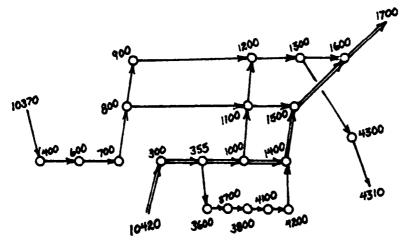
The option for restructuring and "tie-in" points of the integrating activities between the two acquisition processes stems from the fact that the first programming document, the initial DD Form 1391 submittal is not dependent on receipt of the facilities requirements report developed by the weapon system prime contractor. What is needed is notification of the intent to beddown a weapons system at a particular base, so that that base can generate an initial DD Form 1391 input to establish the requirement in the POM. The initial estimate of the amount of money necessary for the facility support of the weapons system beddown need not be precisely accurate since it can be refined with inputs from the later programming documents and finalized before the whole MCP program is submitted to Congress.

Figure 12 shows the original and an amended subnetwork of the programming phase of the integrated acquisition network. The location of the critical path of the whole integrated acquisition network as it passes through each of these subnetworks is shown by the doubled activity line. The computer analysis of each activity in the integrated acquisition network, when it is restructured as shown in Figure 12b is also included as Appendix H.

In the structure shown by Figure 12b, notification of intent to beddown a weapons system would be made concurrent with the SPO's direction to competing contractors concerning the requirements of the full-scale development phase. This

100 200 300 400 4100 4200 400 400 400 4200

a. Original Programming Phase Subnetwork



b. Amehded Programming Phase Subnetowrk

Figure 12
Programming Phase Subnetworks

early notification would allow early submittal of the initial DD Form 1391, and get the construction program (although not the specific required amount) identified as early as possible in the POM. If the operating command for the weapons system had not yet designated an initial host base, the MAJCOM could initiate DD Form 1391 to insure the program inclusion in the POM.

Some rearrangement of activities from the way they exist in Figure 12a is shown by Figure 12b, but no essential activities have been eliminated. They have only been resequenced in a different structure. The computer analysis of this amended structure shows that without crashing any of the programming phase activities, there is only seven weeks of negative slack in the network. All negative slack could be eliminated by crashing the abbreviated and complete project book preparation activities, and even then they would not have to be crashed beyond a time duration equal to the most optimistic completion time for the uncrashed activity.

This network structure also results in only one critical path, allowing management to focus control more precisely and permitting management by exception.

The network structure shown by Figure 12b does not preclude the crashing or extraordinary crashing of activities in the construction phase. It does provide some valuable slack in the design phase, however. Finally, the network structure of Figure 12b still provides the opportunity to stop the facility support project in support of the weapons system

beddown if the weapons system development does not proceed into full-scale development or does not proceed into production.

The structure of the logic diagram of Figure 12b represents only one possibility for relocating the "tie-in" points for integrating activities between the two acquisition subnetworks. Five other possible integrating structures for the programming phase of the network were examined, but they all resulted in more negative slack or required crashing more activities than the one shown, and were thus considered less acceptable than that shown by Figure 12b. This is not to imply that the modified structure shown in Figure 12b is the optimum one possible. More "what if" type analyses of different structural arrangements is necessary to determine the optimal structure that will meet requirements. What is shown is that restructuring can effect better management procedures than the present method of crashing allows.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

The development and analysis of the facility acquisition process and the weapons system acquisition process has been accomplished through the use of PERT networks developed for each process. From the analysis of the stand-alone acquisition processes, an analysis of the compatibility of the two processes was accomplished.

The first steps in the analysis consisted of developing probability distributions for each acquisition process, as they are normally structured and occur. Comparison between the probability distributions showed a marked expected time duration difference between the two acquisition processes, with the expected value of the facility acquisition process being many months longer than the expected value of the weapons system acquisition process, when both are measured from the decision to proceed into full-scale development. (The difference between means is 13 months.)

The second step in the analysis used the network models developed for each acquisition process as inputs into an integrated acquisition process model. This permitted the specific requirements of each subordinate acquisition process to be analyzed in the context of how it impacted the acquisition process as a whole. The integrated network also allowed

analysis of how the two subordinate acquisition processes might be restructured, or their integration structure reoriented to more acceptably meet the time constraints imposed on the whole system.

Conclusions

From this analysis, it was determined that the facility acquisition process is very likely to be a binding constraint on the initial operational capability date established for a new weapons system development. The normal procedures and time tables used in the facility acquisition process are not conducive to meeting the targeted IOC. Instead, extraordinary management action is required to crash activities in the facility acquisition process, to the point where almost all activities in the facilities acquisition process become critical

Restructuring the interface activities between the facility acquisition process and the weapons system acquisition process was examined with a view to establishing different "tie-in" points between the two processes. Analysis of this restructuring showed that it can reduce the amount of crashing required in the facility acquisition process, thus reducing extraordinary management control and saving resources. An example of a restructured network was shown in Figure 12b of Chapter 5.

Recommendations

While the structure of the facilities acquisition process in support of new weapons system beddowns shown in

Figure 12 may not be optimal, it does illustrate that restructuring the process can achieve economies of time and other resources. More study into the relocation of integrating activities between the two acquisition processes is necessary, and this research should be pursued. The benefits possible from finding the optimal structure for integration include a lower risk of exceeding time constraints, lower cost, less direct management attention, and less stringent management control.

Recommendations for Further Study

One area requiring further study is the possible development of a generalized weapons system acquisition model that does not rely upon a particular weapons system as the basis for analysis. The case study approach, as used in this analysis by having the A-10 system as the weapons system acquisition process model, does not give generalized results that can be universally applied.

The specific problems of coordination and responsibility assignment that would be encountered by restructuring the programming phase of the facilities acquisition process need further investigation, as does determination of the optimum structure to be used.

Finally, repeated validation of the results of this study are necessary because of the subjective nature of the input data used as the foundation of this study. Subjective judgments of time estimates could have inherent biases built

in that could be eliminated only by repeating the study and acquiring inputs for time estimates from different sources than were used in this study.

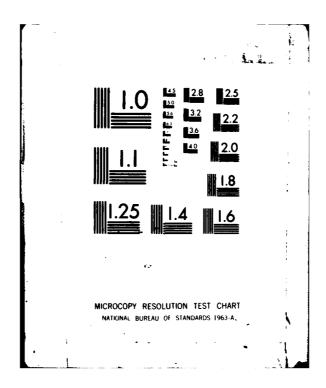
APPENDIX A
FACILITY ACQUISITION MODEL INPUT DATA

Activities Input Data

Note: Times are given in weeks and days format.

Begin Event	End Event	Description	Opt. Time	Most Likely	Pess. Time
99	100	Dummy Network Start	0	0	0
100	200	Facility Requirements Sent to Base	3	5	10
200	300	Facility Survey	42	42	60
200	3600	Initial Environmental Evaluation	26	42	63
300	400	Construction Program Determination	34	42	55
400	600	Initial Documentation Development	- 5	26	55
600	700	Initial DD Form 1391 Development	3	5	10
700	800	1391 Receipt and Review by MAJCOM	42	63	84
700	1000	Abbreviated PB Development	142	171	213
800	900	Program Amendment & Forward to HQ USAF	84	105	121
900	1200	Program Review by HQ USAF	105	126	171
1200	1300	Approved Program Selection by HQ USAF	21	26	42
1300	1600	POM Establishment by HQ USAF	171	213	284
800	1100	MAJCOM Review of 1391	26	42	55
1100	1500	MAJCOM Review of Abbreviated PB	105	126	150
1000	1100	Abbreviated PB Mailed to MAJCOM	3	5	10
1000	1400	Complete PB Preparation	213	255	321
1400	1500	Complete PB Mailed to MAJCJM	3	5	10
1500	1600	Complete PB Review & Mail to HQ USAF	34	4 2	55
1600	1700	HQ USAF Review of Program	60	80	120
1700	1800	OSD & OMB Review of Program	100	140	160
1800	1900	Program Sent to Congress	3	5	10
1900	2000	Congressional Review & Approval	350	360	380
2000	2100	Bills Signed by the President	. 1	3	10
2100	2200	OMB Apportions Funds to AFRCE	13	26	55
2200	2210	HQ USAF Apportions Funds to AFRCE	13	26	55
2210	6200	Financial Planning	30	50	80
6200 2300	2300	IFB Preparation	13	42	55
2300	2400	CWE Preparation	10	13	21

AD-A109 777 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL--ETC F/G 5/1 A STUDY OF TIME CONSTRAINTS RELATED TO FACILITIES ACQUISITION I--ETC(U) UNCLASSIFIED AFIT-LSSR-57-61 NL 2 · 3



Begin			Opt.	Most	Pess.
Event	Event	Description	Time	Likely	Time
2400	2500	Preparation for Award	26	42	42
2300	2500	Bid Advertisement, Formula-	50	63	63
		tion & Receipt			
2500	2600	Bids Opened, Reviewed &	3	5	13
		Approved			
2600	2800	Preconstruction Conference Preparation	11	13	21
2800	2900	Facility Construction	1000	1030	1080
2900	3000	Prefinal Inspection	5	5	5
3000	3100	Correct Inspection	42	63	84
		Deficiencies			
3100	3200	Final Inspection	1	1	1
3200	3300	Facility Transfer	4	4	13
3300	3400	Equipment Installation	42	63	84
3400	3500	Facility & Equip. Checkout	26	42	50
3600	3700	Env. Assessment & FONSI	30	45	60
		Determination			•
3700	3800	EA Presentation to Base EPC	1	1	1
3800	4100	Base JAG & PA Review FONSI	30	40	50
4100	4200	FONSI Publish & Solicit	42	50	60
		Public Comments			
4200	1400	Complete Programming Docu-	3	5	13
		ments			
1300	4300	DI Issue to MAJCOM/AFRCE	1	1	1
4300	4310	MAJCOM/AFRCE Notify Design	5	5	13
		Agent			
4310	4400	DA Preparation for Predesign	1 10	13	21
		Conference			
4400	4500	MAJCOM/AFRCE Collects &	35	40	50
		Reviews Comments			
4400	4600	Conceptual Design	50	60	90
4500	4600	Relay Comments to DA	3	5	10
4600	4800	Early Preliminary Design	100	120	140
4800	4900	MAJCOM/AFRCE Collect &	35	40	50
4000	F000	Review Comments		4.0	
4800	5000	Preliminary Design	30	40	60
4900	5000	Relay Comments to DA	3	5	10
4900	5100	Prep for Early Prelim Design	1 15	20	30
5000	E100	Conference	- 20	7.0	40
5000 5100	5100	Early Prelim Design Continue		30	40
3100	5200	35% Design Notification to MAJCOM	1	1	1
5200	5300	35% Design Notification to	1	1	1
		HQ USAF	_	_	_
5300	1800	35% Design Notification to OSD	3	3	3
5100	5400	Early Prelim Design Confer-	60	80	140
		ence			
5400	5500	MAJCOM/AFRCE Collect &	35	40	50
		Review Comments			

Begin Event	End Event	Description	Opt. Time	Most Likely	Pess. Time
5400	5600	Final Design	60	80	100
5500	5600	Relay Comments to DA	3	5	10
5500	\$700	Prep for Prelim Design Conf.	15	20	30
5600	5700	Prelim Design Continues	20	30	40
5700	5800	Prelim Design Conf Comments	60	100	120
		Incorp.			
5800	5900	MAJCOM/AFRCE Collect &	35	40	50
		Review Comments			
5900	6000	Prep for Final Design Conf	15	20	30
5900	2210	95% Design Notification to	5	5	5
		HQ USAF			
5800	6300	Final Design Details	26	42	63
5900	6300	Relay Comments to DA	3	5	10
6300	6000	Final Design Continues	15	20	30
6000	6400	Final Design Comment Incorp	26	42	63
6400	6100	Final Design Review by	13	26	55
		MAJCOM/AFRCE			
6100	6200	Contract Preparation	21	26	42

Event Input Data

Event Number	Description	(month	Date Required ,day,year)
99	Dummy Start Event		
100	Facility Requirements Defined by Contract	ctor	
200	Base Receives Facility Requirements Repo	ort	
300	Facility Survey Complete		
400	Base Facilities Board Approves Facilities	s	
	Construction		
600	Call Received from MAJCOM		
700	Initial DD Form 1391 Completed		
800	Initial DD Form 1391 Received by MAJCOM		080173
900	Initial Program Received by HQ USAF		101573
1000	Abbreviated Project Book Completed		
1100	Abbreviated PB Received by MAJCOM		120173
1200	Abbreviated PB Received by HQ USAF		
1300	DI Issued by HQ USAF		
1400	Full PB Review Complete		
1500	Full PB Submitted to MAJCOM		070174
1600	Full PB Submitted to HQ USAF		080174
1700	MCP Program Submitted to OSD		100174
1800	OSD/OMB Review Complete		
1900	MCP Program Submitted to Congress		011575
2000	Congress Passed MCP Bill		
2100	President Signs MCP Bill		
2200	Funds Apportioned by OMB		

Event Number	Description
2210	Funds Apportioned by HQ USAF
2300	IFB Ready
2400	CWE Prepared
2500	Construction Bids Prepared
2600	Contract Awarded
2800	Preconstruction Conference Complete
2900	Facility Constructed
3000	Prefinal Inspection Complete
3100	Deficiencies Corrected
3200	Final Inspection Complete
3300	Facility Transfer Complete
3400	Equipment Installation Complete
3500	Facility Ready for Use
3600	CATEX Inapplicability Confirmed
3700	Environmental Assessment Complete
3800	Base EPC Approved EA
4100	FONSI Review Complete
4200	Public Comment Period Complete
4300	DI Issued to MAJCOM/AFRCE
4400	Predesign Conference Complete
4500	Comments on Predesign Collected DA Received Comments
4600 4800	
4900	Early Preliminary Design Review Complete
5000	Preliminary Design Comments Collected DA Received Comments
5100	Early Preliminary Design Conference Complete
5200	35% Design Report Submitted to AFRCE
5300	35% Design Report Submitted to HQ USAF
5400	Preliminary Design Review Complete
5500	Comments Collected
5600	DA Received Comments
5700	Preliminary Design Conference Complete
5800	Final Design Review Complete
5900	Comments Collected
6000	Final Design Conference Complete
6100	Final Design Approved
6200	MAJCOM/AFRCE Contract Review Complete
6300	DA Receives Comments
6400	Design Complete

APPENDIX B
WEAPONS SYSTEM ACQUISITION MODEL INPUT DATA

Activities Input Data

Note: Time is given in weeks and days format.

D	r 1		Time
Begin Event	End	Description	Time Value
10000	10180	Dummy Network Start	0
10180	10190	Prepare Revised Draft DCP	83
10190	10200	Prepare for DSARC Review of Strategy	4
10200	10220	Ratification of Recommendation by Decision Authority	153
10190	10210	Final DCP Preparation	130
10130	10220	Final DCP Approval	30
10220	10230	PMD Finalization	4
10230	10240	Program Control Formulation	13
10180	10240	Continue Baseline Preparation & Analysis	262
10240	10250	Finalize RFP	14
10250	10260	Industry Prepares Reply to RFP	133
10260	10270	Industry Reply Evaluation	94
10270	10290	Final Prototype Source Selection Evaluation	on 66
10290	10300	DSARC I Review & Selection	1
10300	10310	Final Contract Preparation	4
10310	10320	Prototype Engineering	86
10320	10350	Prototype Fabrication & Manufacture A-10	622
10320	10360	Prototype Fabrication & Manufacture A-9	651
10350	10380	A-10 Prototype Flight Evaluation	206
10360	10380	A-9 Prototype Flight Evaluation	180
10300	10340	A-9 Engine Contract Development	542
10310	10340	A-9 Engine Contract Negotiations	545
10340	10360	A-9 Engine Fabrication & Test	202
10380	10390	Air Force Competitive Flyoff	64
10390	10400	Flyoff Results Evaluation	54
10400	10410	Review & Ratification by Source Selection	1
		Authority	
10410	10420	FSD Contract Preparation & Negotiation	60
10410	10430	Engines Contract Preparation & Negotiation	
10240	10370	Baseline Data Preparation & Planning	1132
10370	10420	Basic Contract Development & Planning	290 163
10240	10280	Gun RFP Preparation	345
10280	10330	Industry Reply Formulation & Evaluation	841
10330 10440	10440 10450	Gun Prototype Fabrication & Manufacture Gun Competitive Flyoff	134
10440	10450	Gun Competitive Flyoff Evaluation & Selec.	
10450	10470	Final Contract Preparation & Negotiation	10
10470	11100	Preliminary Modification to Gun Design	76
11100	11120	Preproduction Gun Fabrication	153
11110	11120	Finalize Gun Design	414

Begin Event	End Event	Description	Time Value
11120	11130	Test & Quality Gun	213
11130	10630	Dummy	0
10430	11140	Preliminary Modification to Engine Design	43
11140	11150	Finalize Engine Design	111 385
11150	11160	Preliminary Engine Testing	
11160	11170	Engine Qualification Testing	163 43
11170 11180	11180 11190	Preproduction Engine Fabrication Preproduction Engine Testing	84
	10630		0
11190 11170	11190	Dummy Engine Qualification Testing	120
	12000	Continuing Gun Production & Delivery	1200
11130 11190	12000	Continuing Engine Production & Delivery	1200
10420	10480	Preproduction Design Modifications	93
10420	10490	Finalize Major Component Design	43
10490	10500	Finalize Design	43
10520	10530	Prepare Final Assembly Plans & Jigs	216
10510	10570	Assemble Major Components	40
10500	10520	Prepare Structural Drawings	302
10490	10510	Manufacture & Deliver Forgings	173
10430	10540	Tool Planning Design & Manufacture	182
10540	10550	Tool Release & Set-Up	42
10550	10560	Develop Manufacturing Details	42
10560	10570	Manufacture Components	174
10570	10530	Assemble Substructure	302
10530	10580	Final Assembly A/C #1	42
10580	10590	Ground Testing	84
10590	10600	Preparation for First Flight	20
10600	10610	Preproduction Aircraft Construction	423
10600	10620	Initial Aircraft Testing & Delivery	76
10620	10630	DT&E of Preproduction Aircraft	1023
10610	10630	Delivery & Test of Last Preproduction A/C	666
11270	11280	FOTEE	324
11280	11300	Initial Operational Cadre Training & Qual	315
11300	12000	Dummy	0
10610	11290	Manufacture Production A/C #1	13
11290	11270	IOTEE	214
11290	11310	Equip Test & Training Units	770
11310	11300	Final Preparation & Coordination	232
11290	11310	Continuing Aircraft Production	860
10420	10770	Prepare Vendor Specifications	11
10770	10790	Vendor Reply & Evaluation	50
10770	10780	Dummy	0
10780	10800	Prepare Vendor Contract	70
10790	10800	Final Contract Negotiations	10
10790	10810	Prepare Installation Drawings	543
10810	10530	Dummy	0
10810	10820	Manufacture & Test Components	106
10820	10630	Dummy	0
10800	10830	Manufacture & Test Components	576
10830	10580	Install Components	85

Begin	End		Time
Event	Event	Description	Value
10420	10920	Contract Monitoring & Planning	401
10920	10930	Contract Monitoring & Planning	125
10930	10940	Contract Monitoring & Planning	43
10940	10950	Contract Monitoring & Planning	236
10950	10600	Contract Monitoring & Planning	42
10420	10960	Specification Updating	85
	10970	Determine Gun Interference Data	105
10970	10980	Armor Analysis	196 521
10980	10990	Vulnerable Area Analysis Determine Final Gun Interference Data	302
10990	11000		0
	10630 11010	Dummy	43
11010	11010	Prepare Training Plans Prelim Design of Formal Maintenance	130
11010	11020		130
11020	11030	Training System Final MTS Design	220
11020	11040	Finalize MTS Design Details	170
11030	11050	MTS Planning & Design Review	105
11050	11060	MTS Fabrication	501
	11070	MTS Final Detailing & Delivery	43
11070	10630	Dummy	0
10420	10910	Initial Cost Verification	54Ŏ
	11200	Review Preliminary FSD Data	141
	11210	Ratification of DSARC Recommendations	31
11210	11220	Authorize Long Lead Order	132
	11220	Prepare Long Lead Order #1	304
11220	11230	Prepare Long Lead Order #2	373
11230	11240	Program Cost Verification	34
11240	11215	Review of FSD Data	231
11215	11270	Ratification of DSARC Recommendations	20
	11250	Review of Test Data	85
11250	11260	Review of FSD Data	42
11260	11215	Preparation for DSARC Review	80
10420	10840	Determine Preliminary Design Loads	86
10840	10850	Determine Final Design Loads	351
10850	10860	Vibration & Acoustics Analysis	344
10860	10630	Dummy	0
10840	10480	Dummy	0
10850	10520	Dummy	0
10420	10870	Gun Location Determination	182
10870	10880	Prepare Gun Installation Drawing	432
10880	10590	Gun Groundchecks	216
10420	10890	Prepare Avionics Orders_	202
10890	10900	Avionics Integration & Testing	651
10900	10600	Dummy	0
10890	11080	Negotiate Order	21
11080	11090	Manufacture & Deliver Avionics	391
11090	10580	Install Avionics	131
10420	10670	Conduct Static Article Tests	1181
10670	10630	Dummy	0
10420	10750	Miscellaneous Test Planning	20

Begin Event	End Event	Description	Time Value
10750	10760	Conduct Miscellaneous Tests	1590
10760	10630	Dummy	0
10420	10640	Wind Tunnel Drag Tests	105
10640	10650	Store Separation Tests	216
10650	10660	Flutter Tests	240
10660	10600	Dummy	0
10420	10680	Fatigue Article Test Planning	261
10680	10690	Fatigue Article Fabrication & Assembly	606
10690	10700	Fatigue Testing	344
10700	10710	Continue Fatigue Testing	216
10710	10720	Continue Fatigue Testing	261
10720	10630	Dummy	0
10420	10725	Egress Test Design Modifications	60
10725	10730	Egress Structural Tests	256
10730	10740	Egress Track Tests	214
10740	10600	Dummy	0
10630	11280	Dummy	0 0
11220	11290	Dummy	0

Event Input Data

Event Number	Description
10000	Dummy Network Start
10180	Source Selection Authority Reorients to Competitive
10100	Prototyping Strategy
10190	Revised Draft DCP Prepared
10200	DSARC Review Complete
10210	Final DCP 23A Completed
10220	DCP 23A Approved by Deputy SECDEF
10230	PMD Issued
10240	A-X SPO Fully Established
10250	RFP Issued to Industry
10260	Response to RFP Received
10270	Source Selection Advisory Committee Recommendations
	Briefed to Source Selection Authority
10280	RFP for Gun Issued to Industry
10290	DSARC I
10300	Contractors Selected for Competitive Prototype
10310	Authorization to Award Contract
10320	Prototypes Designated A-9 & A-10
10330	Gun Prototyping Contractors Selected
10340	A-9 Engine Contract Negotiated
10350	A-10 First Flight
10360	A-9 First Flight
10370	Proposal Instruction for FSD Released
	•

```
Event
Number
        Description
        Start Air Force Flyoff
        Flyoff Completed
10390
10400
        DSARC II
10410
        A-10 Selected for FSD
10420
        Contract Award to Fairchild Republic Company for FSD
        Engine Contract Award to General Electric Gun Competitive Shootoff Begins
10430
10440
10450
        Gun Competitive Shootoff Ends
10460
        General Electric Selected for Gun FSD
10470
        Contract Award to GE for Gun
        Design Layouts Complete
10480
10490
        Major Forging Release
10500
        Design Freeze
10510
        Receive Forgings
10520
        Release Structural Drawings
10530
        Structural Assembly Manufacture
10540
        Tool Planning, Design & Manufacture Complete
10550
        Release Tools
10560
        Manufacturing Details Complete
10570
        Structural Assembly Complete
10580
        Final Assembly A/C #1 Complete
10590
        Ground Test Complete
10600
        First Flight A/C #1 (Preproduction)
10610
        Deliver A/C #10 (Preproduction)
10620
        Start DT&E Testing
10630
        Complete DT&E Testing
10640
        Complete Wind Tunnel Tests
10650
        Store Separation Tests Complete
10660
        Complete Flutter Tests
10670
        Static Article Tests Complete
10680
        Fatigue Article Test Planning Complete
10690
        Final Assembly Complete
10700
        One Lifetime Fatigue Testing Complete
10710
        Two Lifetimes Fatigue Testing Complete
10720
        Four Lifetimes Fatigue Testing Complete
10730
        Egress Structural Tests Complete
        Egress Tests Design Modifications Complete Egress Track Tests Complete
10725
10740
        Miscellaneous Test Planning Complete
Miscellaneous Tests Complete
10750
10760
10770
        Release Vendor Specifications
10780
        Issue RFQ
        Select Vendor
10790
10800
        Issue Purchase Order
10810
        Release Installation Drawings
10820
        Qualification Tests Complete
10830
        Receive Components
10840
        Preliminary Design Loads & Criteria Set
        Final Design Loads & Criteria Set
10850
10860
        Vibration & Acoustic Analysis Complete
10870
        Gun Location Freeze
```

```
Event
Number
        Description
10880
        Gun Installation Drawing Complete
10890
        Avionics Long Lead Orders Released
10900
        Avionics Integration & Testing Complete
10910
        Design to Cost Demo Complete
10920
        PDR
10930
        PRR
10940
        CDR
10950
        Safety Inspection
10960
        Specification Update
10970
        Preliminary Gun Interference Data Complete
10980
        Armor Analysis Complete
10990
        Vulnerable Area Analysis
11000
        Final Gun Interference Specifications
11010
        Training Plans Complete
11020
        Formal MTS Design
11030
        MTS Design Freeze
        MTS PDR
11040
        MTS CDR
11050
        MTS PCA/FCA
11060
11070
        Delivery of MTS
11080
        CFAE Ordered
        CFAE Received
11090
        Gun PDR
11100
        Receive Phase I Gun
11110
11120
        Gun CDR
11130
        Gun Qualification Tests Complete
11140
        Engine Hardware Design Complete
11150
        Engine CDR
11160
        AEDC Engine Exploratory Tests Complete
        AEDC Qualification Tests Complete
11170
11180
        Receive Engine #1
11190
        MQT Approval
11200
        DSARC IIIA
11210
        Authorization for Initial Production
11215
        DSARC IIIB
11220
        Long Lead Items Option 1 Funding Point
11230
        Long Lead Items Option 2 Funding Point
11240
        Design to Cost Demonstration
11250
        FCA
11260
        PCA
11270
        FOT&E Program Start
11280
        FOTGE Program End (Phase I)
11290
        First Production A/C Delivery
11300
        Operational Unit IOC
11310
        SATAF Activated
12000
        Dummy Network End
```

APPENDIX C
INTEGRATING ACTIVITIES

Activities Input Data

Note: Times are given in weeks and days format.

Begin Event	End Event	Description	Opt. Time	Most Likely	Pess. Time
10420	100	Facility Requirements Report Generation	213	255	300
3500	11300	Dummy	0	0	0
11310		SATAF Review & Action to Meet IOC	643	771	855
10500	6000	Dummy	0	0	0
(10410	10420	FSD Contract Preparation & Negotiation	1	171	255)

APPENDIX D
FACILITY ACQUISITION NETWORK

This appendix is composed of three parts. The first part is the update history, which lists each activity and event used in the network processing, as well as other data associated with an event or activity and used in the network processing. The column heading format for this part is as follows:

UPDATE CODE - indicates whether entry represents an addition, replacement, deletion or unchanged record. All update codes in this report are labeled A.

PRED - event which signals the start of an activity.

SUCC - event which indicates the completion of an activity (for an event it is the same number as in PREP).

 ${\tt DESCRIPTION - the \ activity \ or \ event \ description.}$

ACCOUNT - not used in this report.

ORG - organization code associated with an activity.

MILESTONE CODE - not used in this report.

ABRS DATE - the actual, scheduled, or required beginning or completion date assigned to an activity.

TIME - the activity time assigned to an activity, expressed in tenths of weeks.

VARIANCE - the computer program has mislabeled this column. The standard duration for an activity (σ_{t_e}) as calculated from its three time estimates (in weeks and tenths of weeks) is calculated and displayed.

The second part of this appendix is the activity report. The activity report displays all the requisite dates and time durations for each activity in the network, as calculated from the input data. The column heading format for this report is as follows:

PRED. EVENT - event which signals the start of the activity.

SUCC. EVENT - event which indicates the completion of an activity.

ACTIVITY DESCRIPTION - self-explanatory.

PROB. - probability of meeting the scheduled date, or if no scheduled date is specified, of meeting the allowed date.

ACTIV. TIME - calculated expected elapsed time ($t_{\rm e}$) when three time estimates are given, or the single time estimate given.

ALLOWABLE DATE - latest allowable date (T_L) for completion of the activity.

DATE COMP/SCHED - if the activity has been completed, the actual completion date (T_A) is shown preceded by the letter A. If a required completion date has been specified, that date (T_R) is shown preceded by the letter R.

SLACK - slack for the activity ($T_L - T_E$)

TIME REMAINING - time from the report date until expected completion date $(T_{\rm F})$ of the activity.

 $\ensuremath{\mathsf{ORG}}$ - identification of the organization responsible for this activity.

The third part of this report is the milestone report. This report displays all the requisite dates and time durations for each event in the network, as calculated from the input data. The column heading format for this report is as follows:

EVENT NO. - event number

EVENT DESCRIPTION - self-explanatory

MILESTONE CODE - first 3 digits of the milestone report flag.

EXPECTED DATE - earliest expected date $(T_{\underline{E}})$ for the completion of the successor event of an activity.

LATEST ALLOWABLE DATE - latest allowable date (\mathbf{T}_{L}) for the completion of the event.

SCHEDULED DATE - scheduled or required date of completion of the event, preceded by an S or R respectively.

ACTUAL DATE - actual date of completion of the event $(\mathbf{T}_{\mathbf{A}})\,.$

SLACK - slack for the event $(T_L - T_E)$

4 1/13/73 200 FACILITY PROVINCINENTS SONT TO BASE SOO SHOE RECEIVES PACIFIES NES REPORT. ----3600 INTTIAL ENVIRONMENTAL SVALUATION SOD PACILITY SURVEY COMPLETE 000 IMITIAL DOCUMENTATION DEVELOR

UNCLESSIFIED

44 JCC-TREMPOSSIVE FORE TOSLORY OFTATVERSE 9498 SOO INTTICL OD FORM 1391 RECEIVED BY MAJEON SOO PROCESS! SHEWSHERT & FORMARD TO HE HEAF RLL/19/73 100 1100 WICOS SEALES OF TANK 800 IMITIAL PROGRAM RECEIVED BY NO URAP

780 INTTIAL DO FORM 1291 DEVELOPMENT 700 INITIAL 1291 COMPLETED

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MCf42+14160

•		900	1200 PROGRAM REVIEW BY ME USAF	47 1717	21	15 10
•		1996	1000 PRESENTATED PROJECT BOOK CONFLETCE		•	
	101		,			
		1900				
		1900	1108 AMREVIATED PO MAILED TO RAJON		-12/ 1/73	• •
-			1400 COMPLETE PO PREPARATION	9436	**	3 17
•		1100	1189 AMPREVIATED PO RECEIVED BY HAJEON			
	111	427 1/1	, , ,		•	
		1100	1900 MAJCOM REVIEW OF ADDREVIATED PO	48 1694	9 7/ 1/76 12	
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			1300 APPROVED MOGRAM SELECTION BY MO WELF	43 4845	A 2/ 1/74 2	
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۵		1300	ASPO DE ESPUÉ TO HAJCON/APROE	V2 1540		
•		1460	1400 FULL PO REVIEW COMPLETE			•
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•		1406	1908 COMPLETE PO MAZLED TO MAJEON	3848	17/ 1/70	• •
٠		2510	1500 FULL PE SUBMITTED TO MAJOR	-		
	191	R 7/ 1/70	•	· · · · · · · · · · · · · · · · · · ·		
		1960	1800 COMPLETE PO REVIEW & MAIL TO BE USAF	, MAJCON	 1 37 1776 - M	
		1000	1840 PALL PE SUBJETTED TO HE USAF	.—		
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٨		1680	1700 M WEAT REVIEW OF PROSERVE	45 4545 1	LLE/ 1/74 83	14
•		1780	1700 HEP PROBLEM SUBMETTED TO 050			
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4		1000	1900 030 tone SCAIER COMPPEAG		•••	•••
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		1800	1900 PROSENT SENT TO CONSMESS	39 (GP LSS	1/10/79 9	•
٠		1960	1900 NO PROGRAM SUBMITTED TO CONGRESS			
	195	4 1/15/75	•			
•		1900	SOOD CONCRESSOURT MEASER & VALUE OF	30-100750	904	•
•	•	2000	2000 COMERCIAS PASSED HEF BILL			•
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•		21 00	2100 PRESIDENT SIGHS HEP BILLS			
	211	910/ 1/75		•		
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2	16		ě.		1/11/73	6/11/73	R 8/15/73	•	136.8		
=		APPREVIATOR OF DECT POOK DEVELOPIN	÷	**	8/27/73	10/11/13		:	197.6		
3		_	6	:	6/21/13	8/2//-3	R11/15/73	:	197.6		
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2	-	COMPLETE OF PEPARATION	-		11.9 /2	4/34/16		:	223.9		
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120	22	-			12/27/73	~	R 2/ 1/76	:	214.3	42 USAF	
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APPENDIX E WEAPONS SYSTEM ACQUISITION NETWORK

This appendix is composed of three parts. The first part is the update history, which lists each activity and event used in the network processing, as well as other data associated with an event or activity and used in the network processing. The column heading format for this part is as follows:

UPDATE CODE - indicates whether entry represents an addition, replacement, deletion or unchanged record. All update codes in this report are labeled A.

PRED - event which signals the start of an activity.

SUCC - event which indicates the completion of an activity (for an event it is the same number as in PREP).

DESCRIPTION - the activity or event description.

ACCOUNT - not used in this report.

 $\ensuremath{\mathsf{ORG}}$ - organization code associated with an activity.

MILESTONE CODE - not used in this report.

ABRS DATE - the actual, scheduled, or required beginning or completion date assigned to an activity.

TIME - the activity time assigned to an activity, expressed in tenths of weeks.

VARIANCE - the computer program has mislabeled this column. The standard duration for an activity (σ_{t_e}) as calculated from its three time estimates (in weeks and tenths of weeks) is calculated and displayed.

The second part of this appendix is the activity report. The activity report displays all the requisite dates and time durations for each activity in the network, as calculated from the input data. The column heading format for this report is as follows:

PRED. EVENT - event which signals the start of the activity.

SUCC. EVENT - event which indicates the completion of an activity.

ACTIVITY DESCRIPTION - self-explanatory.

PROB. - probability of meeting the scheduled date, or if no scheduled date is specified, of meeting the allowed date.

ACTIV. TIME - calculated expected elapsed time ($t_{\rm e}$) when three time estimates are given, or the single time estimate given.

ALLOWABLE DATE - latest allowable date (T_L) for completion of the activity.

DATE COMP/SCHED - if the activity has been completed, the actual completion date (T_A) is shown preceded by the letter A. If a required completion date has been specified, that date (T_B) is shown preceded by the letter R.

SLACK - slack for the activity $(T_L - T_E)$

TIME REMAINING - time from the report date until expected completion date $(T_{\rm E})$ of the activity.

 $$\operatorname{\textsc{ORG}}$ - identification of the organization responsible for this activity.

The third part of this report is the milestone report. This report displays all the requisite dates and time durations for each event in the network, as calculated from the input data. The column heading format for this report is as follows:

EVENT NO. - event number

EVENT DESCRIPTION - self-explanatory

MILESTONE CODE - first 3 digits of the milestone report flag.

EXPECTED DATE - earliest expected date $(T_{\overline{E}})$ for the completion of the successor event of an activity.

LATEST ALLOWABLE DATE - latest allowable date (T_L) for the completic \imath of the event.

SCHEDULED DATE - scheduled or required date of completion of the event, preceded by an S or R respectively.

ACTUAL DATE - actual date of completion of the event $(\boldsymbol{T}_{\boldsymbol{\Delta}})$.

SLACK - slack for the event $(T_L - T_F)$

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06 - 01		TACK CORCINES	9.	~	21.42.21		9.6		
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10520		PLY PLANS C 2365	25.2		4/11/6		;	244.6	
18530		=	•		3/1/14		•	252.8	
11500	10950 TOLL RELEASE C SET-UP	9	:	1/11/13	3/1:1/6		:	24 e	
10 550		NG DETAILS	:	9/11/73	8/11/1/6		0.0	2.1.5	
10560		213	17.0	1/23/14	1/23/76		•	.13.	
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10630	11280 00 147		0.0	2/16/17	3/ 1/77		1.0	374.4	
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29901	FATEGUE	FICATION & ASSEMFLYS	P7.5	**	51/53/1		35.6	501.0	
16 69	FATTONE		36.0		3/22/76		35.6	2.45	
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11040	1 1050	HIS PLANTIN & DLSIGN REVIEW	3: 1		2/ 4/26		9.0	24. •b	
11050	11060	ALL COTACON SELECTION OF THE SELECTION O	21.5		111111		:	٠. ج	
11.060	1 1070	FT FT FT TO TOTAL TO CELIVERY	4.6		3/ 1/17		:	40.462	
11.670	10430		••	7/31/15	4. 18 /1		:	19:04	
11.000	11090	MATURALLY CELIVE AVIONICS	39.2	-	46/56/9		;	234.0	
110%	10660	TH! TAL. 14 THIES	13.5		17/17		;	2440.1	
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11110	11120	ETTOFILE CITY DESIGN	•		*		=	25.2 04	
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11.130	1 98 30		•		3/ 1/17		107		
1113	12000	COMMISSION PRODUCTOR & DELIVERY	121.0		1111111		*	37	
*1:1	11150	elrettes sitted besten	=				*	14:4	
11150	11.0	PEFLIM FUSINE 1ESTING	39.0		~		4.00	25.00	
2117	11170	LINE THE TETENTON FESTER	1.91		3/ 5/18		30.4	1.46.4	
11170	11.00	FILESONING OF ENGINE FAMICATION	•		\$4.0P /\$?	****	
11170	11190	ENGINE PUBLICITATION TESTING	12.0		5/13/16		-	2,00,	
11100	11190	pelesonition Engine TESTING	•		6/11/8		*	25. · ·	
11.19	10830	(n-4/		~	1/ 1/77		110.4	247.8	
2617	2080	COLITITION FUEINF PREDUCTION & DELIVERY	7		1 3/17/77		20.	177.8	
11200	11 210	FAITFISHING OF CSAKE RECOMMENDATIONS	3.5		1/35/74 12/13/76		0.7	24446	
11 210	11220	AUTHOFF TO 1, 7116 LEFD ORDER	13.4	-	3/2.2/8		2	0.753	
11 215	11270	MATIFICATION OF DSAKE KCOMMENDATIONS	7.7		7/ 3/76		0.61	4.4.4	
	11230	PRIFAR LOVE LEAD UPDER 02	2.0		15/16/10		0.61	**562	
	11290				11/ 1/74 11/26/74		9	\$0.76.3 0.76.3	
11 230	1120	PERSONAL COLL VERIFICATION			1777			20667	
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11211		THE COLUMN TO TH		42/3//	2000			3	
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06311		CONTRACTOR OF THE PROPERTY OF					4	1.1.	
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11 360	12000	TOTAL SOURCE OF TOTAL OF THE PROPERTY OF	-	7////	10/1/1/1		9	7.0.4	
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LEWEL/Strangery ITEM 2/				3	71.00 ()00	677.77	
		RELEASE DI	RELEASE DATE: 1.71.769				
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10:10 AUING 17:11:4 TO AMADO CONTRACT	122	12/22/10	12/22/78			<u>.</u>	
	123	2/26/71	37 3/71			3.0	
10 130 SUN P. STSTAFFAG CONTRACTORS SELECTED	124	1/36/1	A/ 9/71			14.2	
	123	1/12/12	1/19/72			-•	
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APPENDIX F
INTEGRATED ACQUISITION NETWORK

This appendix is composed of three parts. The first part is the update history, which lists each activity and event used in the network processing, as well as other data associated with an event or activity and used in the network processing. The column heading format for this part is as follows:

UPDATE CODE - indicates whether entry represents an addition, replacement, deletion or unchanged record. All update codes in this report are labeled A.

PRED - event which signals the start of an activity.

SUCC - event which indicates the completion of an activity (for an event it is the same number as in PREP).

DESCRIPTION - the activity or event description.

ACCOUNT - not used in this report.

ORG - organization code associated with an activity.

MILESTONE CODE - not used in this report.

ABRS DATE - the actual, scheduled, or required beginning or completion date assigned to an activity.

TIME - the activity time assigned to an activity, expressed in tenths of weeks.

VARIANCE - the computer program has mislabeled this column. The standard duration for an activity (σ_{t}) as calculated from its three time estimates (in weeks and tenths of weeks) is calculated and displayed.

The second part of this appendix is the activity report. The activity report displays all the requisite dates and time durations for each activity in the network, as calculated from the input data. The column heading format for this report is as follows:

PRED. EVENT - event which signals the start of the activity.

SUCC. EVENT - event which indicates the completion of an activity.

ACTIVITY DESCRIPTION - self-explanatory.

PROB. - probability of meeting the scheduled date, or if no scheduled date is specified, of meeting the allowed date.

ACTIV. TIME - calculated expected elapsed time ($t_{\rm e}$) when three time estimates are given, or the single time estimate given.

ALLOWABLE DATE - latest allowable date (T_L) for completion of the activity.

DATE COMP/SCHED - if the activity has been completed, the actual completion date (T_A) is shown preceded by the letter A. If a required completion date has been specified, that date (T_B) is shown preceded by the letter R.

SLACK - slack for the activity $(T_L - T_E)$

TIME REMAINING - time from the report date until expected completion date $(T_{\rm F})$ of the activity.

ORG - identification of the organization responsible for this activity.

The third part of this report is the milestone report. This report displays all the requisite dates and time durations for each event in the network, as calculated from the input data. The column heading format for this report is as follows:

EVENT NO. - event number

EVENT DESCRIPTION - self-explanatory

MILESTONE CODE - first 3 digits of the milestone report flag.

EXPECTED DATE - earliest expected date $(T_{\mbox{\footnotesize E}})$ for the completion of the successor event of an activity.

LATEST ALLOWABLE DATE - latest allowable date (\mathbf{T}_{L}) for the completion of the event.

SCHEDULED DATE - scheduled or required date of completion of the event, preceded by an S or R respectively.

ACTUAL DATE - actual date of completion of the event $(\boldsymbol{T}_\Delta)\,.$

SLACK - slack for the event $(T_L - T_E)$

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•	10420	LOGIO SPECIFICATION UPPATING	91	-•
•	10420	11010 PREPARE TRAINING PLANS	••	-1
A	104 36	10430 ENSINE CONTRACT ANARO TO GE		
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	10430	11100 PRELEM MODIFICATION TO EMELIAC DEGIGN	••	-6
- A	10440	18408 GUN COMPETITAT SHOOTOPF REGING		
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4	100-00	18486 GU+ COMPETETEVE FLYOFF	120	-4
4	10490	18099 GUM COMPETETS VE BHOSTOPF ENDS		
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•	10490	10400 GUI COMPETITIVE FLYOFF EVAL & SCLOSTIBUS	**	-8
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A	10700	10400 DESIGN LAYOUTS COMPLETE		
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A	10470	100 TAJOR FOREZHE RELEASE		
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•	10170	19570 STRUCTURAL ASSEMBLY COMP	304	-0
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		2		21/8/12	•	-27.3		
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-		E .	_	1,121,	•	•		
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					1 - P. D. D. T.	AC DATTAG ORGA.	ACTIVITY REPORT SN. C	#6P047	CONTRACT NO.	- MO-						
THIE	AYES A	1211003	ACCUPANT SOLLESSINGS COLVESSINS	34.13	1517/15	2 5							- 44.4	TERM ION IN YERK CAL	ر د د	
ATA LEUS 1ST	11.	200	4C5733 2	25FF C14573 . 4 17 NO.									RLFORT	REFORT DAILS 1.71 /09	69/ 1	
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ğ	2 7 91	10410	- e to 141	10490 ISLOAD TATALES LEGIST	I FOLKS			≈	1: 4:12	2122173	11 3/7		3.5	193.4		
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9	02.01	10850		dul	DERINATE & DATEGRAPH TO THE PARTIES	N I K G		٠ د		12/16/73	9/22/7			5 1 T . 2		
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9	200	11010		131.5.1	TO TO THE	INF DE	, NSIX			2000	1/1 / 6 / 6		98.3	9		
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Ž	10 - 50	10460		ALLILICI	SUI STATETITY FLYCFF EVEL C SELECTIONS	135 1 7	LECTTONS	•		11 1/17	1/31/1		9.7	135.3	2	·
2	9460	10470		JULIUS B	FIRST COSTACT PARP & NECOTIATION	TIATION	*	-		111173	1/21/2		9.2%	\$ 42° a		•••
2	2401	2 2		4771616	NOIS30 NOS (L HOLLY) LUCA FIRTH	000		•		5/0/13	3/2/24		9			
9	96.0	200		2 2 2	FILTER TO COMPONENT DESIGN	ESIGN		•			11/17/76		72.	1:1.5		
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9	92590	16530		24 1.1.12	SOLE I SWELL WILLIAM STATE OF THE	NS C. J.	IGS	72		7/3/13	11 3/16		~	, ,,		
9	20 20	1050		FILL 193F 1718 ANC 05	50 2/1	,		-			2/ +/76			200.1		
2	3	10550		TOL STEERED & STAUP	10-1.			•			12/11/121		.	19:43		
2	10550	10560		13/2014	STREE ONTHE CLINE OF THE	11.S				0/11/73	1/11/1			, , , 2		
9	3	10670		STUBER THE CHOCKENIS	OF ENTS			2		1/23/74	2/10/15		÷	4.4.4		
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9 9	90.00	94501		001101011101010010010010010010010010010	SECURE TO STREET BUTCHE	-		• ^	7.1 4.2	12/ 2/14	97 67 5			, r.		
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	909	10620		13/2-614	INJITIA, ATOMOFT TESTING & DELIVERY	DEL IV	¥	•	,	1733775	4718178		10.	2.47.7		
•	10610	10630		15-4 1 4	HILLYSTY TTST OF LAST PREPROD A/C	00243	A /C	29	67.2 2/	27 9/17	27 3778		71.2	373.4		
2	10619	11290		Date -cit.	THE SEATTHE PEODUCTION N/C . 1			-		1.726775	3/ 1/17		66	6. 5		
3	23	10630		Addresse.	PICE OF SPISSOFUCTION ALECRAFT	RAFT		162.6		2/16/77	77 37.8			374		
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ğ	10660	999		•				; –		* (/35/)	411		101.8	ra · m,		
3	10,70	200	1744	;				•		31/1 //	77 377R		163.4	291.2		
3	06901	3		3 104.26	FATESHE SETTOLE FASRICATION	. A.	C ASSETPLY!	61		21/14	31/21/14 11/12/18		101.0	25.04		
3	06901	10700		911.231 167.110				ŕ		1136175	11:111		101.0	2.96.2		
=	10700	10710		541116	FATISHE TELLING CONTINUES			2		9/76	1/ 8/76 12/23/77		101.0	317.4		
25	10710	22/01		441.55	FFILED TESTING CONTINUES		,	2 -		7/ 9//6			101.0	4.5.4		
<u> </u>	2 2 2	10770		START TENDENCE AL TESTS	75575		•	. 2	24.2	22/22	1 /22/2 11/14/75		101.0	2		
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		NIONO	UNCLASSIFIED				1 1110	
			TIME					
		BED ONTINCOSS	1,403	CONTRACT NO.				
INTES- 1TE	F	INTES-1TE: PERMISTATION HER MADE	7.0			Tcf H•	TLIM- IAN SI YEAR CAL	
15T S.P.T FL		ARES CLIDES AND THE R.C.				7. F.	R.FURT DAIL - 1./1./19	
AND SHOT KEY		70m _han_e117 106				K: L: A	RELEASE DATE-16/16/09	
JAN S.F.T VE	_	Let 1 414Cc						
ATH SJET RE		SERVICE COME CALL						
CVEAT			A37 14.	•	3110	3416	NEAL 1216	
ر 34 4	'n	WOLLDTAN OF SEKIPTION	408. TIE	EXPICTED	ALL DYFA COP	PROB. TIME EXPECTED ALLOWER COMP/SCHEF SLACK	K TITE ONG.	:
07.701	10740		21.12		167.67	106.0		
10746	10660		د.	4// 5 / 124	2	105.0		
10750	10760	COLUMN TITLE STS	7 6 ± W	92/1/2	8//1 //	110.6		
1076	7.9630	44,	-	2/1/26	77 31 TA	110.5		
10770	10750	(a) 14 H(;	3/13/73	4/15/-4	72.8	-	
10770	18790		•	4/64/73	479.72	78.3		
10780	10000				11/1/14	72.b	•	
97.01	00001			5/ 1/73	11/ ///	72.5		
00.201	10010	D. I SBOT TITTEL ATTON DI ANTINGS	20.08	1/21/76	1/ 3/78	82.0		
101.00	1000		5.62	f/24/74	12/ 1/76	72.1		
10110	20.00		1	1/5//	1/1-/1	82.0		
10410	10420		11.2		77 3778	6.971		
66.401	10630		3		N. / / / / / / / / / / / / / / / / / / /	9.4		
96.901	10500		. 6	1/21/14	3.19.12	7.5		
9001	10490				1 1/14/76	76.0	-	
900	10050		200	1/11/76	11:115	77.2		
10860	10520		9		8414614	77.2	7 0 7 1 1 1	
2501	10060	VIE-ATT 14 * ACOUSTIC ANALYSIS	34.0	-	7/ 1/-R	102.4		
20801	10640	Jh: (i !	¥• J	42/47/5	1/ 3/78	102.4		
10 970	10800		4.8.4	11/21/74	11/29/75	73.0		
10 : 10	10530		25.2		47 507R	73.0		
9,001	90601		2. 19	11/ 7/7	4/1.17F	73.6		
1080	11000		**		1/23/75	73.2	_	
10900	18600		:	~	4/1.1/5	4.6.6	• •	
1001	11800		14.2	1/17/	3/15/18	4.70		
10910	11280	ISTERDAL FOR THE OF DEL ME	31.1	-	7/21/26	4.7.		
10920	1097		3.61		912,176	72.5		
02601	0000		9:		9/5:1/6	72.6		
9601	10960		21.42		1/11/16	72.6	. 20% a	
986	18680	-	4.	=	4/1.1/5	74.6		
10 040	0.001		11.0		4173178	144.0		
10970	16910		% : X	12/16/73		148.0	•	
10980	06601	_	52.5	-	-	240.0		
9 66 01	11000	CATE - MENT FIRE GUN JWTERFERENCE DATA	30.46			146.0		
11000	10630		<u>.</u>	8/11/18	77 377R	146.9		
11010	11020			7/ 5/73	92.41/9	149.2		
11020	11010			•	11/10/16	144.2		
110 30	11040		17.0		3/18/77	149.5		
210.0	11050				6/ 5/77	2.4.7		
110%	11000	こうれんこうかい かんな	2.96	1121115	5/31/78	2.641	9*162	

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				ACTIVITY REPORT	1904							
WT: 2847.7	AC 74115	2002.57	AEPOLIENG O		5 .	P. 4				TO SEE TO MAIL CHOIL		
A STATE OF A		- C	27/17		:				70.016	DIVINITE THE STATE OF THE STATE		
NO JAR FEY		אחנו לו יה בתוח מני						_	261.45	RELATE DATE-16/11/C9	63/	
en siet et		1.1 1.40										
TH ,767 <ev< th=""><th></th><th>SEESCIES NITE (TES)</th><th></th><th></th><th></th><th>,</th><th></th><th>į</th><th></th><th></th><th></th><th></th></ev<>		SEESCIES NITE (TES)				,		į				
1. A 1					-	ACTIV.		OATE		FEALINING		
	, . X	MOLLATION LESCENDATION	CC IPTION		. T.	EXPLCTED		ALLOWIN COMP/SCHED SLACK	31 ACK		<u>د</u>	
303	13670		G DELIVERY		•		77 3778		7.5.1	90,52		
2011	10430		-		9		7/ 3/7R		149.12	70.75		
8 =	110.00		HE AVIONICS		39.5		172174 1373977F		73.2	23.00		
2	16560		•		12.8	1783/14	3./1 /2		7.3.5			
1118	11110		BRECATION		15.6	•	7/11:17		3.4	4. 1.		
2 ::	2112		-		=======================================		5/11/76		.3	2, 204		
11120	11.30		и ;		21 · 6		11/11/1		18.5	274 1		
11130	1060		-		:		1/ 1/24	_	1:0.0	27:00		
21 11	12000		ותכוסה כ מקרב	VERV	1200		3/21/10		08.0	: **62		
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13 150	11160). 9		35.		3/121/6		10.0	227.6		
211	:1170		# TESTING		16.6	1/3//	27 7778		e o o	54:43		
11 170	11.80	_	FAT ICATEO	*	9:	1/31/3	8/ 4/7F		٠. ٠ ٠	24.4.0		
11170	11190		N TESTING		12.1	•		•	7.001	2:to.		
1118	11190		NE TESTING		9:9		-		٠.۶	P*, (.)		
11 180	10630				-	•	7/ 3/-R		1:: F	2:7 .4		
11 18	1 2 000		PENDUCTION !	OEL I VEVY	126.0		2/21/79		3	373		
11 200	11210		IFC FICOMMEND	ATTONS	3.5	1/3:/74	1/101/1			244.4		
11.210	11220		DKO TH		13.4	~	7/21/7			25.5.5		
11215	11270		INC RECOMMENDA	TIONS	~		11/11/17		f.	32		
11 220	11230		FRER 02		32.6	7/31/75	_		÷.	40.505		
11.28	11280				:	11/ 1/74		•	116.4	25.00		
11230	11240		CATION			4/12/13	41/21/3			2.44.		
11240	11215				23.5	23.2 :/12/76	-		3.	322.		
271	11.250					1 /5/ /2			63.	3.6		
11.25	11260				•	•	8/4.874		2.50	312.6		
11.240	11215		FC KEVIER		•		10/11/11		~! ~ ~	9. 7.		
11.270	11290	_			32.0		4/ 3/78		£ 5.5	302.04		
11 240	11300	•	CAD-E TRAIN	ING C 188	35.5	_	5/3:179		~	4,00,4		
11 680	11270	•			21.1		-		35.2	329.6		
11230	11310		NG UNITS		7.2		4:/1 /6			36405		
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11 300	12000			5.			5/211:0			.70.4		
11 310	2000		T TOC IPRECE	DESCE	2		8/		2.2	34.08		
11 310	11300	FIRST SPEEDS TION C COOSDINATION	COOGDINATIO	2	23.4	1. 111/11	5/2-179		٠ دو.	4.9°2		

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	ALTHEORY OF SERVICES	PERITING HILESTONE REPORT MA. CO	T CONTRACT NO.			9 A GE
1361. 1	AF171.S	,	1:5		TERM JAN 12 YEAR CAL REPORT DATE- 11/12/69	CAL 11/11/69
LEVEL/SURLARY 17Em 2/		DE16456	04/ 21/41. STAT 5.24.3 140			
			LATEST			
	WIL ESTON	DN. EXPECTED	ALLONABLE	SCHTONLED	ACTUAL	SLACK
100 FEF 11 117 5			2/21/73			-27.8
	EFORT	9/12//3	2/21/13			-27.8
_	:	3 11/16/73	3/29/73			-27.
100 BLE EP SEE THE EATILY CONSTR	NSTR	11/16/73	\$ 2/8 /3			-27.8
_		12/11/73	123/73			-27.8
BOD BELLIAL CO FLOAT 1704 JEC LIVED BY MAGGON	IN BY MAJCON	2/ 5/14	1/36/73	R 4/ 1/73		-27.5
	PLE 1:0	1/22/74				2017
	AJCC4 11		11/31/73	411/11/73		9.7-
_		#	41751174			-17.4
			3/3: /76			-27.6
	3 .		7//92/2			3
MANUAL CO. C.		11/ 1//4				1 1 1 1 1
: :	7.1		7/1 //1	R11/1/7		-2
			1/ 9/75			-24.4
			1/15/75	4 1/13/15		-2
	2 :		3/24/16	****		٠. ٥.
STAIL AS CLASSIANCE AND STAIL BOOKS		3/53/16	11.7.17.5	K11/ 1//5		
	3 %		1/11/16			
2300 3F= 6743Y	25		7/19/76			3.0
	92		8/ 3/76			0.5
SAMO CONTROL WINE SECOND	~ :	9/ 1/16	9/ 1/76			;
2 400 PF CO STAINTEN CONTROLENCE GOVERNMENT		6	4/21/76			ب ر د د
			01/62/3			3
		_	1.7 6/70			g.,
STATE TO THE PROPERTY OF THE PARTY OF THE PA	25	9//5/17	11/24/7			•
	? *		12/ 1/70			
			1/22/19			•
			2/21/79			6.6
	37	_	3/ 6/74			24.1
STATE STATE STATES AND STATES CONTINUES		11/19/73	6/11/76			10 C C
BURNING BURNING BURNING CONTRACTOR	~		5/11/5			20.1
			£127774			20.7
	3	_	2/14			-10.7
tale be wollflig of of		1/11/1	6/12/74			-10.7

						FAGE
1198	98	č	CONTRACT NO.	Har.	TFOM IAN 1. VEAK CAL REPORT DATE: 1./1"/69	CAL 1./1°/69
		SELEASE DI	RELEASE DATE, 1./11:769			
			LATEST		1711	274.5
EVERT 40.	2000	DATE	. DATE	3047E	DATE	35.454
MSTC303 IN	9	9/36/74	1/24/74	1		-13.7
03173771-3 1:15-13ed 10 31. 34-13 0054		17/ 6/74	A/ 1/74			
1660 D. RE PERE C COPPERTY	ij	10/23/74	41/9 /0			-17
BEFINDU MILA E TELESE ALLE ALIVE AT 11 9009	v.	\$1/12/1	11/ 1/74			-11.7
	Š	2/13/18	15/ 3/74			-13.7
SAME PROFILE OF STATES	24	2/2:/15	12/11 /74			-11.7
		3/18/75	1/ 2/19			-11.7
		1/19/75	1/ 3/75	11/29/74		-17
	35	\$1112/8	1/ 6/15			-17
		9/11/15	4/16/75			16.6
	<u>.</u>	6/11/19	11/ 5/75			10.6
3.500 Ex FEDERA II COMATANA	57	7715/15	11/12/75			16.6
5700 BILLI 1 D: <164 CD-1F note ETE	5 3	8/13/18	12/ 4/75			16.8
	2	19/13/75	2/12/76			16.0
	?	11/12/75	3/12/16			10.3
	3.	12/ 4/75	1/ 2/76			16.6
	÷	1/3//16	F 127 176			16.6
	50	6/16/76	6/11/16			
	÷	11/18/78	3/18/76			16.8
64.80 DFS764 CrapteTF	~	1/ 7/76	27 73	17/ 1/79		70.0
760 INITIAL 1391 234PLETEN	9	12/10/73	5/31/13			-27.8
CALCULATED IL MERON: ST13" OF 16VK CALANDAR	Ä					
10100 SEA F. DETENTS TO THAT THE PROTO STRAT	RAT 1:9				18/11/83	-27.0
CALCHLATER TL. REFORM STANT OF SEVE CALANDAR 10-19 OF SEVEN CALANDAR	1.9	69/31/21	12/12/69			-27.8
CALCULATED IL BIFORE STANT OF ALMA CALAMOAN	. *					
10206 nobpt DE VIEW 3340ETT	111	12/10/69	12/10/69			-27.8

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-27.4

3/17/16

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CALCULATED TE BEFORT START OF SEVE CALANDAR 10210 FINEL DCP 214 STARTTO CALCULATED TE BEFORT START OF 21 YE CALANDAR 10220 DCP 23A AFPEDWES BY DFPUTY SECUEF

-27.0

1/18/19

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PA TERM JAM 30 VEAR CAL REPORT DATE: 1740/40	1
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INTESCATE ACOUISITION NETWORK

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TIMES EATTSOME TESTING COMP	163	1/ 9/16	1/3/78			11 100
STRUCTURAL PETS COPP	154	10/22/73	11/14/79			115.0
T 11 11 25 TEN WARE CLMP	145	4/16/73	51 9110			7
dour Strait Mirel	156	3/27/76	91/13/1			1.50
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	175	6/2-174	12/ 1/75			72.8
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Callo, FR: EPE	179	7/13/73	12/26/74			73.6
STALLATION JOHNTHG COMPLETE	189	5/21/74	1: /28/75			73.6
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CC BUTFGOLTEDY & TESTING COMPLETED	102	11/ 1/14	4/26/76			73.4
I TO COST 1540 COMPLETE	193	3/27/76	12/16/75			47.4
-	104	12/16/73	6172215			72.6
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$\begin{tabular}{ll} APPENDIX & G \\ INTEGRATED & ACQUISITION & NETWORK, & CRASHED \\ & FACILITIES & SUBNETWORK \\ \end{tabular}$

This appendix is composed of two parts. The first part is the activity report. It displays all the requisite dates and time durations for each activity in the network, as calculated from the input data. The column heading format for this report is as follows:

PRED. EVENT - event which signals the start of the activity.

SUCC. EVENT - event which indicates the completion of an activity.

ACTIVITY DESCRIPTION - self-explanatory

PROB. - probability of meeting the scheduled date, or if no scheduled date is specified, of meeting the allowed date.

ACTIV. TIME - calculated expected elapsed time ($t_{\rm e}$) when three time estimates are given, or the single time estimate given.

 $\label{eq:expected_date} \mbox{EXPECTED DATE - earliest expected date } (\mbox{T_E}) \mbox{ for completion of the activity.}$

ALLOWABLE DATE - latest allowable date (T_L) for completion of the activity.

DATE COMP/SCHED - if the activity has been completed, the actual completion date (T_A) is shown preceded by the letter A. If a required completion date has been specified, that date (T_R) is shown preceded by the letter R.

SLACK - slack for the activity $(T_L - T_E)$

TIME REMAINING - time from the report date until expected completion date $(T_{\rm F})$ of the activity.

ORG. - identification of the organization responsible for this activity.

The second part of this report is the milestone report.

This report displays all the requisite dates and time durations for each event in the network, as calculated from the input data. The column heading format for this report is as follows:

EVENT NO. - event number

EVENT DESCRIPTION - self-explanatory

MILESTONE CODE - first 3 digits of the milestone report flag.

LATEST ALLOWABLE DATE - latest allowable date (\mathbf{T}_{L}) for the completion of the event.

SCHEDULED DATE - scheduled or required date of completion of the event, preceded by an S or R respectively.

ACTUAL DATE - actual date of completion of the event $(\textbf{T}_{\Delta})\,.$

SLACK - slack for the event $(T_L - T_E)$.

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APPENDIX H INTEGRATED ACQUISITION NETWORK WITH AMENDED PROGRAMMING PHASE

This appendix is composed of two parts. The first part is the activity report. It displays all the requisite dates and time durations for each activity in the network, as calculated from the input data. The column heading format for this report is as follows:

PRED. EVENT - event which signals the start of the activity.

SUCC. EVENT - event which indicates the completion of an activity.

ACTIVITY DESCRIPTION - self-explanatory

PROB. - probability of meeting the scheduled date, or if no scheduled date is specified, of meeting the allowed date.

ACTIV. TIME - calculated expected elapsed time ($t_{\rm e}$) when three time estimates are given, or the single time estimate given.

ALLOWABLE DATE - latest allowable date (${\rm T_L}$) for completion of the activity.

DATE COMP/SCHED - if the activity has been completed, the actual completion date (T_A) is shown preceded by the letter A. If a required completion date has been specified, that date (T_R) is shown preceded by the letter R.

SLACK - slack for the activity $(T_L - T_E)$

TIME REMAINING - time from the report date until expected completion date $(T_{\rm F})$ of the activity.

 $\ensuremath{\mathsf{ORG}}.$ - identification of the organization responsible for this activity.

The second part of this report is the milestone report. This report displays all the requisite dates and time durations for each event in the network, as calculated from the input data. The column heading format for this report is as follows:

EVENT NO. - event number

EVENT DESCRIPTION - self-explanatory

MILESTONE CODE - first 3 digits of the milestone report flag.

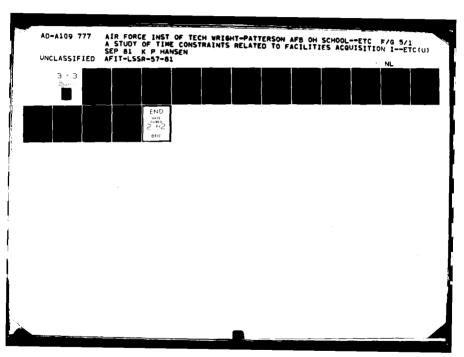
EXPECTED DATE - earliest expected date $(T_{\underline{E}})$ for the completion of the successor event of an activity.

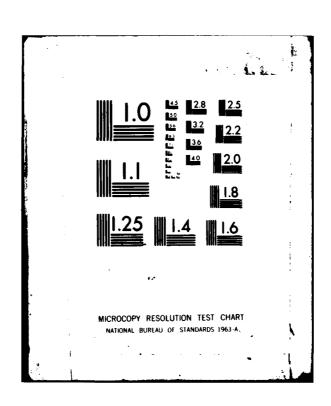
LATEST ALLOWABLE DATE - latest allowable date (T_L) for the completion of the event.

SCHEDULED DATE - scheduled or required date of completion of the event, preceded by an S or R respectively.

ACTUAL DATE - actual date of completion of the event $(\mathsf{T}_\Delta)\,.$

SLACK - slack for the event $(T_L - T_E)$.





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